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AUGUST 1961

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Maintain liquids at a constant, predetermined level in open tanks

When you install Hoffman Float Valves, you always have just the precise quantity of liquids required in your open storage tanks, process tanks, cooling tower basins . . . tanks won't overflow, nor will liquid level drop below specified range. Hoffman engineered Float Valves, available in either globe or angle pattern, have brass bodies, seamless copper floats, and special "Buna-N" discs for reasonably clear liquids with a maximum temperature of 200°F. Sizes: ¾" to 3": operating pressures to 100 P.S.I. maximum.

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Radiator Vents | Main Vents | Radiator Traps | Hot Water Circulators | Condensation Pumps | Temperature Regulators | Strainers

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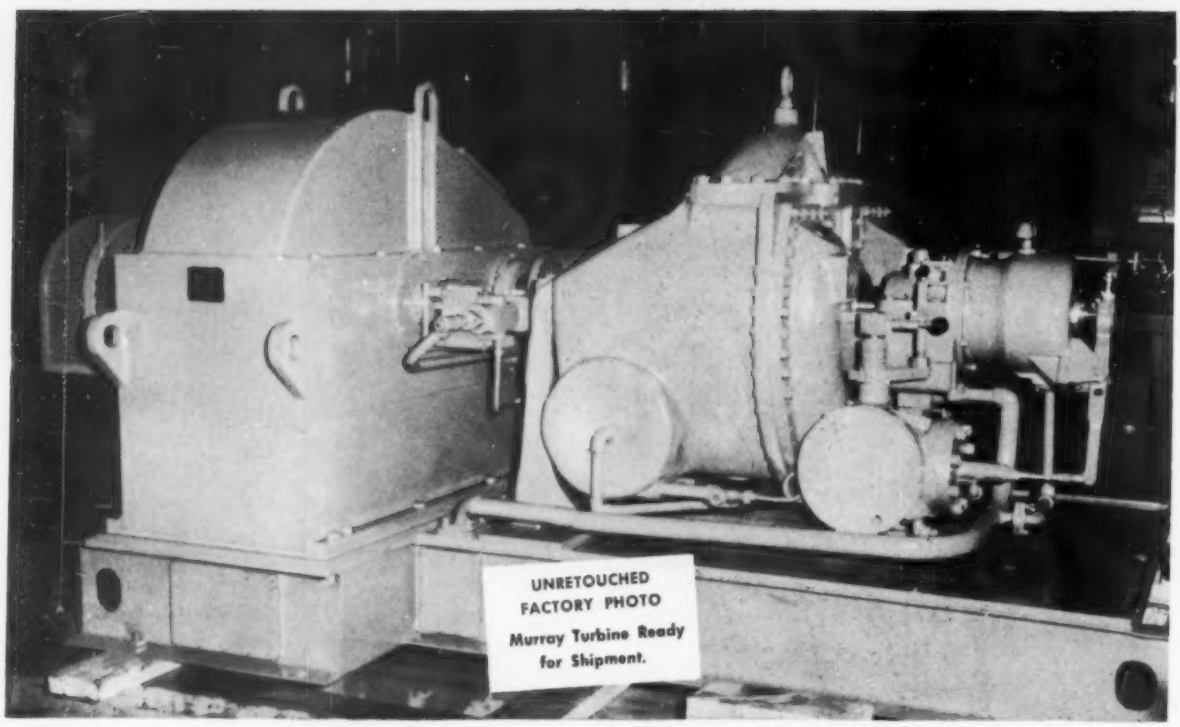
Murray
TURBINES



Murray Type U Mechanical Drive Turbine and Gear, 1200 HP @ 4300/880 RPM. Steam Conditions are 580 PSIG, 700°, 75 PSIG Exhaust.

Murray Iron Works Company Turbines are built to stand up for many years of trouble-free economical operation. Each unit is engineered to the highest standards. Spare parts fit properly as received from the factory regardless of the number of years the turbine has been in service.

What better proof of the attention to detail both in engineering and shop craftsmanship?

The true economy of Murray Turbines speaks for itself after years of trouble-free operation. Write today for information on Murray Turbines to meet your requirements.

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Comment

Another milestone has been added in the remarkable development of high-voltage transmission. American Electric Power and Westinghouse have energized the Apple Grove, W. Va., project at 750 kv, and will use it for research in EHV.

This is one of the main reasons why the American power industry leads the world in new developments. And, judging from the past, we'll continue to lead — and make practical use of what we learn in research.

Bob McCaw

EDITOR

Power Engineering®

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ON THE COVER

This spectacular unit has the magnetic confining coils, part of the C-Stellarator project at Princeton University, to be used for plasma research. See L. J. Linde's article on this facility — on page 56. (Photo courtesy of Allis-Chalmers)

POWER ENGINEERING is published monthly at 308 E. James Street, Barrington, Illinois. Telephones: DUnkirk 1-1840, (Chicago) NEwcastle 1-0488. Change of address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Please allow 60 days to make the change effective. Subscription information: Published monthly, price in the U. S. and possessions $10 per year; in Canada $11 per year; other countries $12 per year; single copies $1. Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries. Microfilm edition: Request prices from University Microfilms, Inc., Ann Arbor, Mich. All volumes since 1948.

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Accepted as a controlled circulation publication, Columbus, Ohio.

around the power circuit

Radioisotope-fueled automatic weather station, built by Martin Co., will transmit up to 1500 miles, operates 2 years without refueling

AS A RESULT of over four years of engineering studies and planning, three Minnesota power suppliers will build four new major high-voltage interconnections that will bring the benefits of pool operation to electric customers in north central Minnesota.

The three companies are Otter Tail Power Co., Fergus Falls; Northern States Power Co., Minneapolis; and Minnesota Power and Light Co., Duluth.

These four interconnections, requiring the construction of 135 miles of 115,000-v transmission lines and costing over $3,100,000, are another important step in strengthening the Minnesota Grid.

WORLD'S FIRST atomic powered automatic weather station has been built by The Martin Co. for AEC. Ready now to be moved to a remote location north of the Canadian mainland, it gets its power from pellets of a strontium-90 compound which generate heat spontaneously by radioactive decay.

The heat is transformed directly into a continuous five watts of electricity by a series of thermoelectric couples. The electrical energy is stored in rechargeable batteries in order to build up the power needed to operate the long-range reporting transmitters.

In the operating generator, the fuel pellets are encased in several layers of an alloy called Hastelloy-C. Radiation from the strontium-90 in the working generator is blocked by lead. Final protection for the whole generator is an outer cladding of stainless steel.

SUPERCONDUCTOR material which offers no resistance to appreciable quantities of electrical current has been developed by Atomics International, a division of North American Aviation, under a research contract with the Atomic Energy Commission.

A wire which can be easily coiled has been drawn from the new superconductor. At liquid helium temperatures (—452 F) the wire has conducted 100,000 amp of electrical current per square centimeter in a moderately high magnetic field (30,000 gauss).

The new material is a cold-worked alloy made up of approximately three parts of niobium to one part of zirconium. The alloy is malleable and strong and can be made into wires, bars, strips and other shapes without losing its superconducting properties.

EXTRA-HIGH-VOLTAGE common carrier power intertie between the Pacific Northwest and Pacific Southwest has been proposed, and a preliminary report has been submitted by Bonneville Power Administrator Charles F. Luce. Luce is chairman of the Interior Department's five-man task force named in March to undertake the study.

"On the basis of this preliminary report," Interior Secretary Stewart L. Udall states, "we believe the proposed intertie holds great promise of mutual benefit to both areas, by taking advantage of the diversity of loads, coordination of thermal and hydro plants and disposal of power surpluses during certain periods.

"Accordingly, I am requesting the task force to make every effort to complete their studies and final report by not later than Nov. 1, 1961."

FEDERAL POWER COMMISSION has granted the Public Utility District No. 1 of Snohomish County, Wash., a 50-year license for a proposed hydroelectric project on the Sultan River in Snohomish County. Estimated cost of the proposed construction is about $42,500,000. Three powerhouses will have a total installed capacity of 141,200 kw.

FPC has also approved the proposed merger of Pacific Power & Light Co. of Portland, Ore., and California Oregon Power Co., of Medford, Ore. Pacific Power & Light will be the surviving corporation.

FPC has authorized Arkansas Power & Light Co., of Little Rock, to acquire all of the electric facilities of Arkansas Utilities Co., also of Little Rock. Purchase price of the facilities is $3,300,000.

REPORT titled "The Training, Placement and Utilization of Engineers and Technicians in the Soviet Union" is based on a tour of the Soviet Union made last year by six representatives of United States engineers. The group was sponsored by Engineers Joint Council, with financial support of the National Science

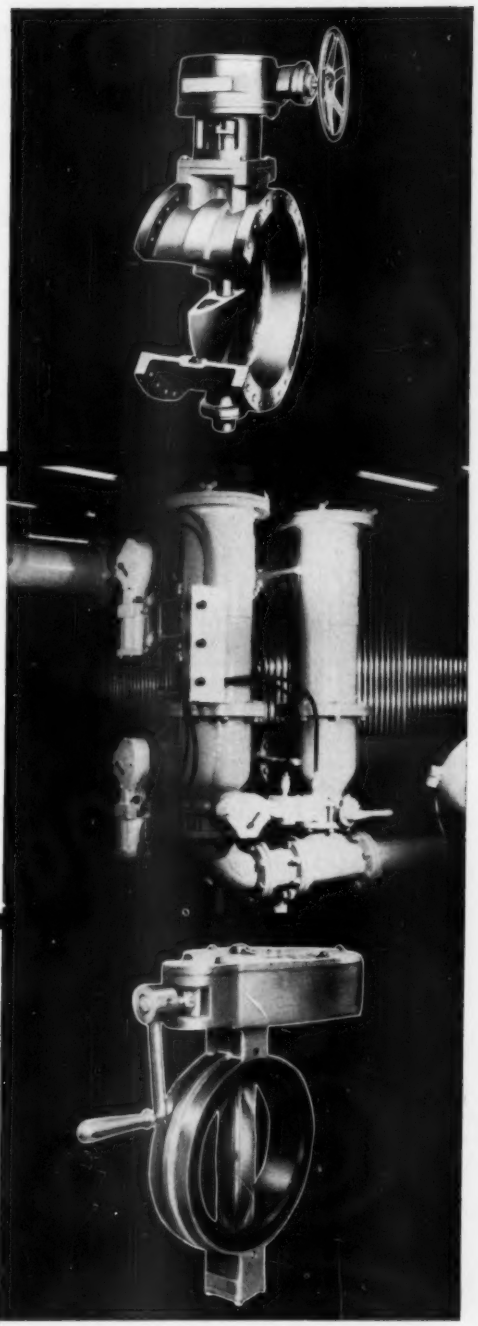
PRATT POWER PLANT PRODUCTS are all NEW for the '60's

NEW Rubber Seat Butterfly Valves

The time-proven Henry Pratt features are now augmented by such new design features as: ADJUSTABLE SEAT that can be tightened, or even replaced without removing shaft or disc. LOWER SEATING TORQUES, lowers actuator cost and provides remarkable ease of operation. Longer operating life through accurate control of disc-seat interference, giving tightness, without wear.

The new Pratt Butterfly Valves are available in sizes 3″ through 144″ and for pressures to 150# in both wide and narrow face-to-face. Also furnished with integral expansion joint.

Write for complete information.



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The new Pratt Cyclone Strainer eliminates the manual cleaning usually associated with this type of equipment. Backwashing operations are completely automatic and can be accomplished in seconds.

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Patented "Cyclone" action keeps larger particles away from basket—keeps strainer "on the line" longer.

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Write for Bulletin D-10-G.

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Foundation, and under an exchange agreement between the U.S. and the U.S.S.R.

The 112-page printed document, including footnotes, statistical data and photographs, is available in limited numbers for $1.00 from Engineers Joint Council, 29 West 39th Street, New York 18, N.Y.

around the power circuit

BUILDING of the proposed **$1,025,000,000 San Francisco Bay Area rapid transit system will be one of the great construction projects of modern times. Among other things, construction of the 120-mile high-speed rapid transit network will require $85 million worth of electrical materials and equipment.**

CONTRACT for nearly $12 million goes to Babcock & Wilcox Co. to furnish a cyclone furnace-fired supercritical Universal Pressure steam generator for Public Service Electric and Gas Co.'s new Hudson Generating Station at Jersey City, N.J.

When the boiler goes on-line in early 1965, it will be the largest steam producer in the utility's system. The unit will develop 2,450,000 pounds of steam per hour at a pressure of 3625 psi and a temperature of 1000 F for a 400,000-kv turbine-generator. It will have two reheaters; the first for 1025 F and the second for 1050 F. At full load, the unit will burn approximately 2960 tons of coal daily

POTOMAC ELECTRIC POWER **has appropriated $105 million to construct a new steam generating station in Prince George County, Va. The plant will house two 335,000-kw turbine-generator units, the largest in the PEPCo system. It is expected that the first unit will be placed in operation in 1964 and the second unit in 1965.**

NEW TYPE OF ROPE — made of alumina silica ceramic fiber that withstands temperatures up to 2300 F— helps solve costly downtime problems in boiler furnaces. It's from the Carborundum Co.

General application is in the expansion joints of refractory-lined boilers. Here the rope provides essential resiliency, yet prevents slag and other foreign matter from freezing the joints.

325,000-KW atomic power plant will be built by Pacific Gas and Electric Co. at Bodega Bay on the Sonoma County coast 50 miles north of San Francisco. The plant will be powered by a boiling water reactor to be made by GE.

PG&E estimates the station will cost $61 million and will produce electricity for slightly less than six mills per kwh. Said PG&E president Norman R. Sutherland: "As with all our atomic projects, we will build Bodega Bay with our own money. There will be no government subsidy or financial contribution from any other source."

Further, PG&E believes electricity produced at Bodega Bay with nuclear fuel will be economically competitive with electricity that could be generated in a conventional steam plant (gas and oil fueled) at that location.

The Bodega Bay plant will be fueled by approximately 75 tons of uranium, equivalent to more than 3 million tons of coal, which is expected to run the plant for 3½ years. The plant will utilize pressure suppression containment, developed by PG&E, which allows the reactor to be installed below ground. Sea-water evaporators will provide the Bodega plant with fresh water for the reactor and steam system, and other uses.

FINAL COSTS for New England's first atomic-electric project will run about $13 million below the estimates, reports President William Webster of Yankee Atomic Electric Co. Final capital requirements for the Yankee project at Rowe, Mass., will be about $43,700,000 compared to the $57,000,000 estimated at the time financing arrangements were set up.

So far the atomic-electric project has turned out over 400 million kwh of electricity, or about four per cent of the normal electric load in New England.

FORMAL DEDICATION of the 600-Mw, $110-million Robert A. Gallagher station at New Albany, Indiana, on June 20 brought to completion a ten-year program of improvement by Public Service Co. of Indiana, Inc. During this period, $393 million have been invested in transmission, distribution and generation facilities, said chairman Robert A. Gallagher.

Two or more units will be added in the future, and will range from 200 to 500 Mw in capacity. Interconnected-company studies indicate that single, 1000-Mw units may ultimately be used.

NEW KIND OF TRANSFORMER that may become a major innovation in power technology has been invented by Dr. Richard McFee of Syracuse University, and Arthur D. Little, Inc. The new transformer has been successfully operated at a level of 15 kw.

According to Dr. McFee, transformers using the new design could be considerably lighter and less costly than conventional transformers; and they would not be subject to the substantial power losses caused by electrical heating, or to the temperature limitations of present-day electrical insulation.

The new design makes use of superconductivity — the ability of certain metals to conduct an electrical current without any resistance at temperatures near absolute zero (minus 459.6 F).

When an electric current flows through a coil, such as the windings of a transformer, powerful magnetic fields are generated about the windings and quench the superconductivity when they reach a critical field strength.

Dr. McFee discovered that interleaving layers of the primary and secondary windings would keep the total magnetic field strength below the critical level.

The Gifford-McMahon helium refrigerator invented at A. D. Little provided a solution to the problem of finding a simple, reliable method of maintaining the superconducting coils at the necessary low temperature for an extended period.

THERE'S NO "OR EQUAL" TO DEARBORN'S ENDCOR® FOR COOLING WATER TREATMENT

1. No treatment. 2. Chromate-polyphosphate mixture—50ppm. 3. Chromate-polyphosphate mixture plus Endcor A—50ppm.
Unretouched photographs showing the effect of Endcor A in cooling water treatment at a pH of 6.5 and a temperature of 130° F.

Today, there's more than two years of performance proof behind Dearborn's cooling water treatments with the research developed additive, Endcor.

And today, more and more companies, with millions of dollars worth of cooling systems and equipment to protect, are striking out the "or equal" clause and directly specifying one of these Endcor products.

There's Polychrome ® 501 and 505 with Endcor A . . . Dearborn ® 860 with Endcor B . . . and others —all designed to do specific corrosion and deposit inhibiting jobs more precisely, more effectively, and, in many cases, more economically.

Behind these products are important "pluses," too. There's Dearborn's experience dating back to 1887 —longest in the water treatment field. There's its extensive research facilities . . . its modern, completely equipped laboratories to provide truly scientific answers to specific and baffling problems . . . its Technical Centers in Chicago and Toronto staffed with recognized experts to back up products and Dearborn engineers in the field.

Because of its critical importance to overall results, Dearborn also provides the most complete and effective line of chemical feeding equipment of any water treatment company.

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who

The Elmer A. Sperry Award for the year 1961 is being made jointly to **R. G. LeTourneau** in recognition of his development of earth-moving equipment, and to the Research and Development Division of the Firestone Tire and Rubber Co. in recognition of its pioneering the giant-size, heavy duty tires which made such equipment feasible. The award will be officially presented on September 12, 1961, at a meeting of the Society of Automotive Engineers in Milwaukee.

Miles N. Clair, president of Thompson & Lichtner Co. of Brookline, Mass., has been elected president of the American Society for Testing Materials.

L. M. Shadgett, vice-president of Georgia Power Co. and Athens division manager since 1937, has been named vice-president and general manager, with offices in Atlanta. **Ben W. Burton**, Athens division superintendent since 1952, succeeds Shadgett as vice-president and Athens division manager.

Clarence H. Linder (right), president of AIEE, pins a badge on **Warren H. Chase**, Cleveland, AIEE president-elect. Chase is vice-president of the Ohio Bell Telephone Co.

Clifford H. Shumaker has been nominated to serve as president of the American Society of Mechanical Engineers. He would begin his term in June 1962, following a mail ballot of the membership this fall. Shumaker is chairman of the Department of Industrial Engineering of Southern Methodist University, Dallas, Texas.

J. L. Price, system dispatcher, Southern California Edison Co., has been elected president of the American Power Dispatchers Assn.

Illuminating Engineering Society has elected **James R. Chambers**, of Chicago, president for 1961-1962. Chambers is sales manager of Lighting Products Division, Appleton Electric Co.

Homer P. Binder, consultant in Allis-Chalmers' fluid dynamics department, retired July 31 after 50 years of service in pump engineering and sales.

E. L. "Leo" Bebb, who served Westinghouse for 40 years, has joined Henningson, Durham & Richardson, engineers and architects, Omaha.

Frederick Carlton Gardner, president of Ebasco Services, Inc., has received the Honorary Degree of Doctor of Science from North Carolina State College.

Godwin Williams, Jr., has been appointed assistant director of TVA's Division of Power System Operations.

Owen W. Hurd, managing director of Washington Public Power Supply System, has received the Distinguished Service Award, highest honor conferred by the American Public Power Association.

what

Commenting on Dr. Abetti's article on Project EHV, published in the June issue, **Basil Payne** of Central Maine Power Co. writes:

> I have just read the very interesting and informative article on EHV by Dr. Abetti, and note that this is the first of a series. . . . You are to be congratulated on publishing these articles, this one in particular being the most comprehensive and "meaty" of any I have yet seen.

Commonwealth Edison Co.'s construction expenditures for the five-year period, 1961-1965, are estimated at $720 million. **Willis Gale**, chairman, states:

> Our transmission line interconnections with other systems are becoming increasingly valuable in the economic planning of generating additions.
>
> For example, our existing 345,000-v interconnection with American Electric Power makes it possible for us to arrange for a firm purchase of 300,000 kw from that system for the summer of 1964. This assured supply allows us to defer the completion of one 560,000-kw generating unit from 1964 to 1965. Also, we have assumed that we will be able to defer a second one of the same size from 1965 to 1966.

AEC has announced the titles of 126 AEC-owned French patents on which it will grant licenses for royalties. Inquiries should be addressed to the U.S. Atomic Energy Commission, Washington 25, D.C., attention, Office of the Assistant General Counsel for Patents. Abstracts of patents may be obtained free from Reports and Industrial News Branch, Office of Public Information, AEC.

when

First U.N. Conference on New Sources of Energy will be held in Rome, Italy, Aug. 21-31.

AIEE will gather in Salt Lake City, Aug. 23-25, for its Pacific General Meeting. Place is the Hotel Utah.

Sixteenth annual ISA Instrument-Automation conference and exhibit will be held Sept. 11-15 at the Biltmore Hotel and Memorial Sports Arena in Los Angeles.

Association of Diesel Specialists meets Sept. 14-17 at the Leamington Hotel in Minneapolis.

Fourth Biennial Gas Dynamics Symposium is scheduled for Aug. 23-25 at Northwestern University, co-sponsor with the American Rocket Society. MHD will be featured.

Industrial Building Exposition & Congress is scheduled for the New York Coliseum, New York City, Sept. 25-28.

American Welding Society will hold its national Fall meeting at the Hotel Adolphus in Dallas, Texas, Sept. 25-28.

Engineers Council for Professional Development will hold its 29th annual meeting on Oct. 2-3, at the Sheraton-Seelbach Hotel in Louisville, Ky.

Solid Fuels Conference, co-sponsored by ASME's Fuels Division and AIME's Coal Division, will be held in Birmingham, Ala., Dinkler-Tutwiler Hotel, Oct. 5-6.

BOILERS TO GO!

Delivered to the installation site by rail, truck or boat, shop-assembled Vogt Package Water Tube Boilers can be quickly placed in operation. After being placed from the carrier onto a simple low-cost concrete slab, a Vogt unit requires only piping, electrical and stack connections to go to work.

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A pressure type steel casing permits outdoor operation, if desired, eliminating the need for an expensive building.

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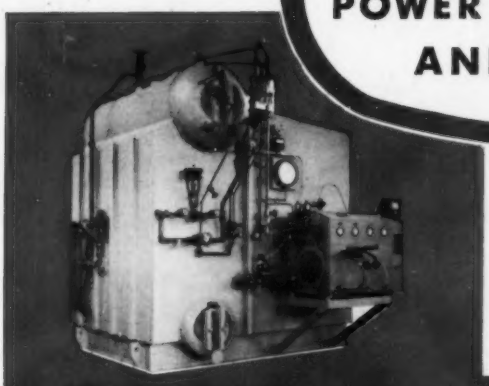

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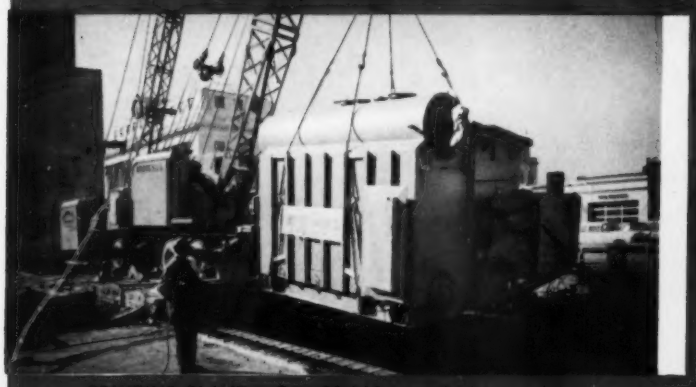

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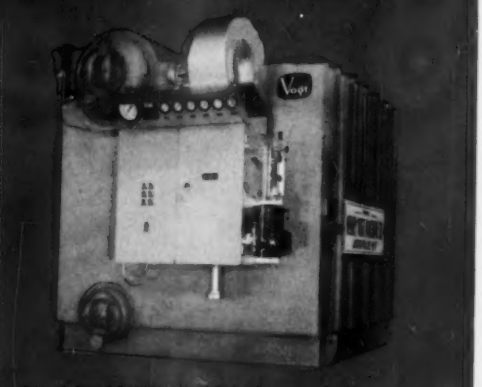

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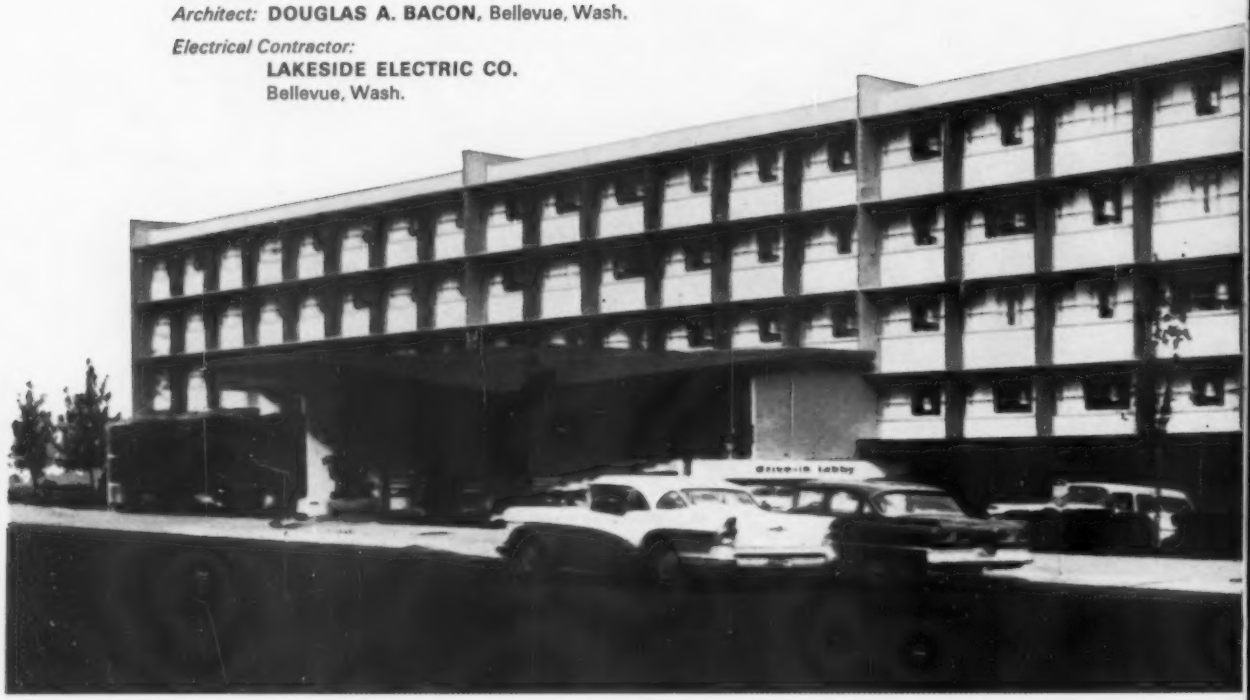
Architect: **DOUGLAS A. BACON**, Bellevue, Wash.
Electrical Contractor:
LAKESIDE ELECTRIC CO.
Bellevue, Wash.



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These modern services require large electrical capacity. As a result, the available fault current is approximately 70,000 amperes.

Safe protection against faults of this magnitude is assured by the BUSS Hi-Cap fuses installed in the main entrance service. These fuses have an interrupting rating of 200,000 amperes rms. symmetrical.

To maintain safe, modern protection throughout the electrical system,—and to safeguard against unnecessary interruptions in electrical service, FUSETRON dual-element fuses are installed in the branch circuit switches.

ANOTHER BUSS HI-CAP AND FUSETRON FUSE INSTALLATION

There is a safe, modern BUSS or FUSETRON fuse with specific characteristics to match your requirements.

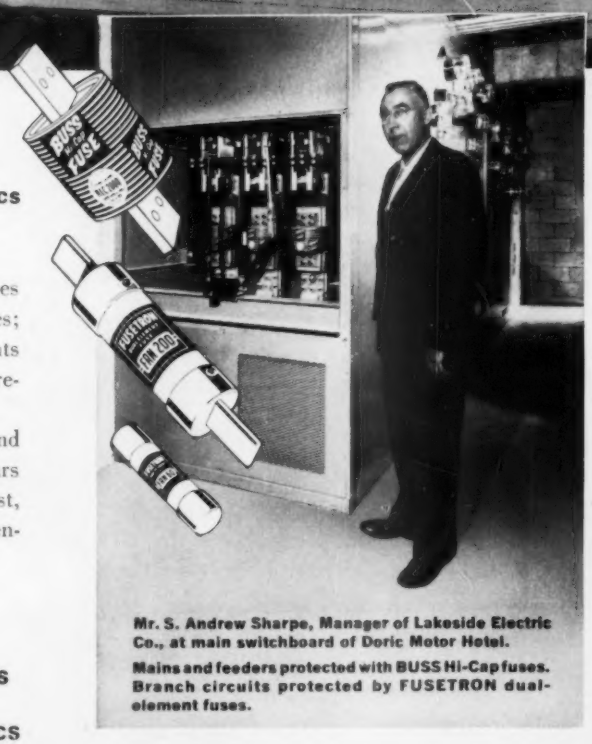
Available from BUSS: High interrupting capacity fuses to protect against fault currents up to 200,000 amperes; current-limiting fuses to restrict let-thru fault currents to safe values; long time-lag (dual-element) fuses to prevent needless outages on harmless overloads.

And with Fuses safe protection remains safe. BUSS and FUSETRON fuses are just as safe and accurate 20 years or longer after installation as on the day installed. Dust, fumes, corrosion or age cannot prevent them from opening when they should.

For more information on

FUSETRON dual-element fuses
(loads of 0 to 600 amps.) ..... **write for bulletin FIS**

BUSS Hi-Cap fuses
(loads above 600 amps.) ..... **write for bulletin HCS**



Mr. S. Andrew Sharpe, Manager of Lakeside Electric Co., at main switchboard of Doric Motor Hotel.

Mains and feeders protected with BUSS Hi-Cap fuses. Branch circuits protected by FUSETRON dual-element fuses.

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.* **ST. LOUIS 7, MO.**

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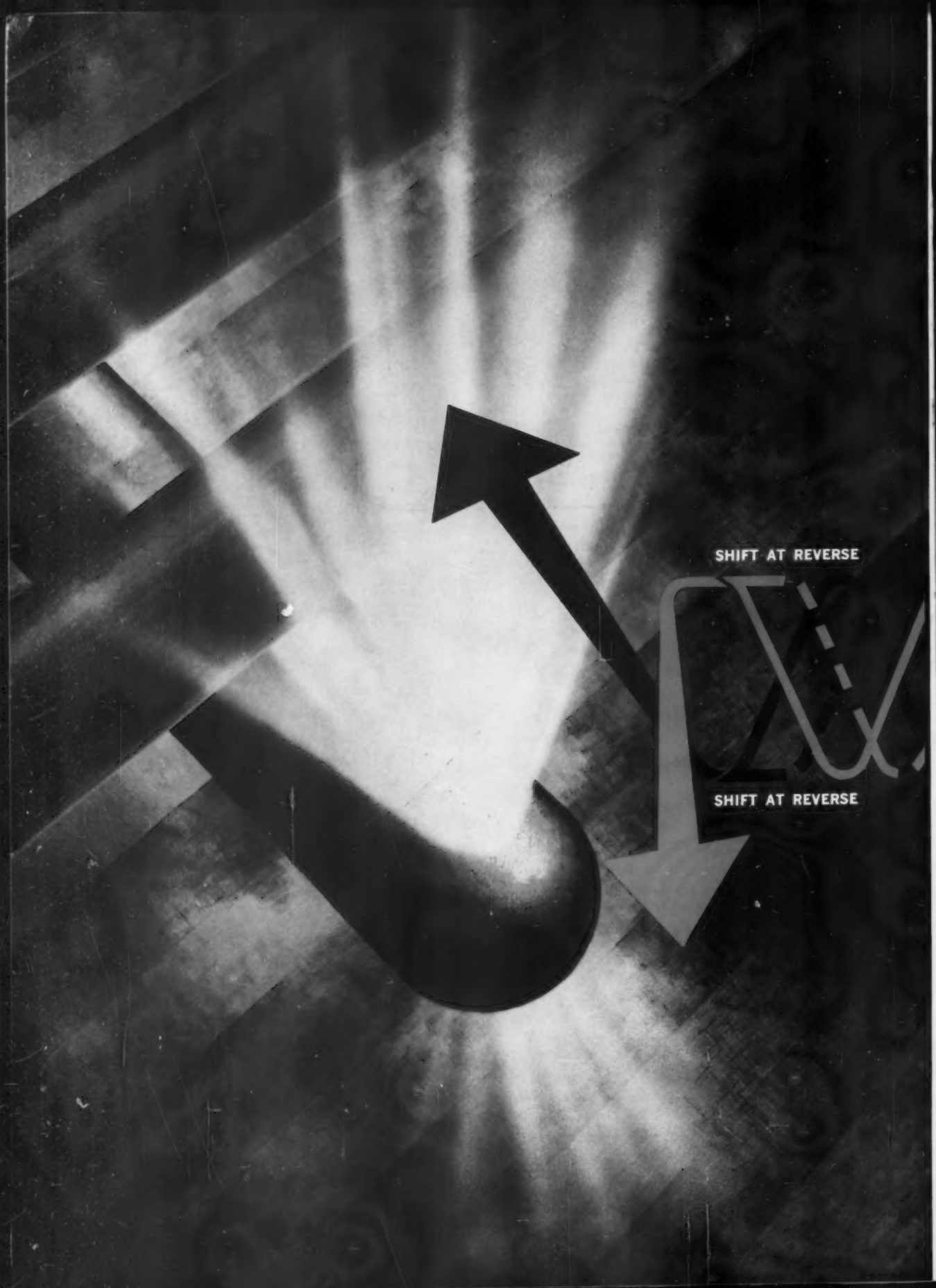
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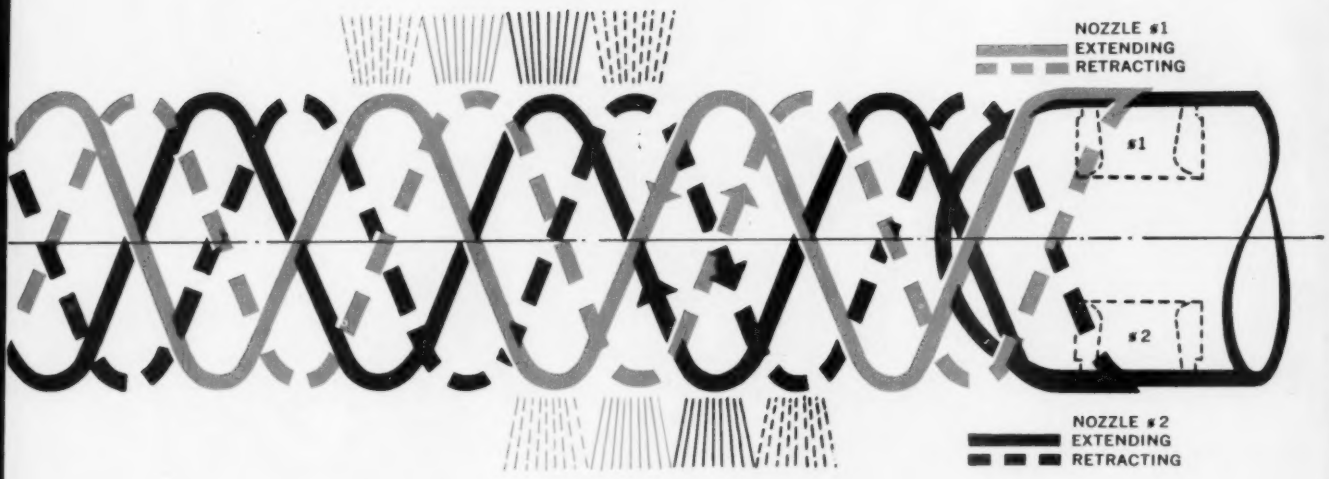
Get uniform, complete cleaning in those "tough-to-clean" zones. Specify Diamond's IK-300 Retractable Blower. The exclusive close-spaced IK helix assures a penetrating nozzle sweep every inch of travel regardless of tube bank arrangement and tube spacing. What's more, because sectionalized lance tube construction cuts deflection to a minimum, smaller boiler cavities are possible. In addition, a unique method of equalizing nozzle end-thrust assures "minimum-wobble" travel regardless of distance.

IK's are just part of the reason behind Diamond's established superiority in boiler cleaning systems. Add a complete line of cleaning equipment, an experienced, imaginative engineering staff and an unmatched service organization. No wonder thousands of utility and industrial power plants are equipped with Diamond Cleaning Systems — engineered and designed to provide you with more economical power.



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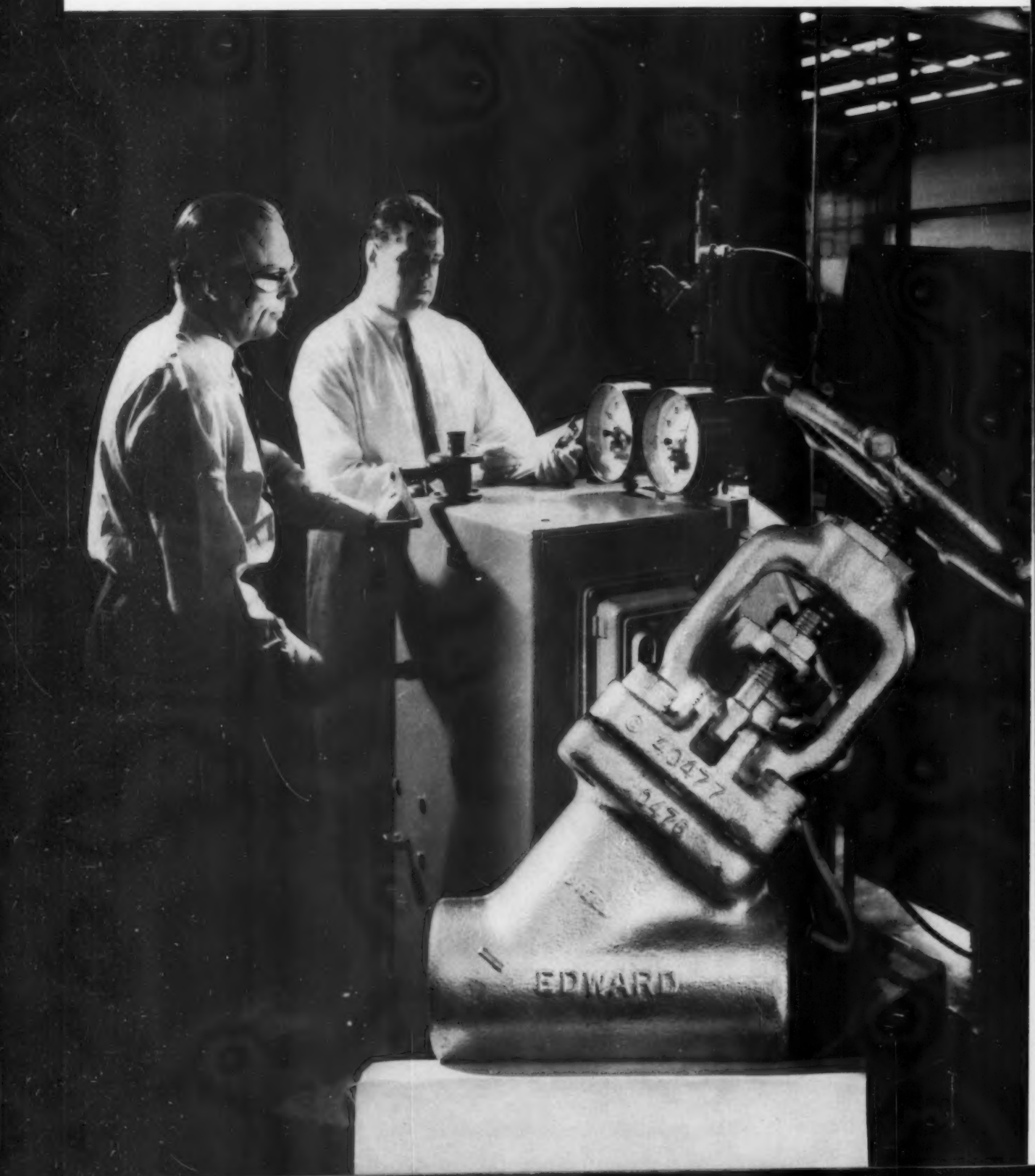
DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio • DIAMOND SPECIALTY LIMITED, Windsor, Ontario

The Story of Edward Research



and the "Perfect" Globe Valve

Edward designers built the Figure 848 forged steel globe valve from scratch. In an art where most development effort must be directed toward modification, adaptation, and refinement of existing technology, the 848 story is almost unique. The objective was simple: To design and construct a perfect 600-lb-class globe valve in the ¼" to 1" size range. (Basic rating 600 lb at 910 F, 2000 lb WOG.) That the project was virtually successful is a tribute to the ingenuity of the Edward Research Staff and the equipment which enabled them to validate their progress. Here, is that story.

Three areas were given special consideration by the Edward staff of engineers and metallurgists when they set out to design a "perfect" valve. They were: 1. Body Shell and Bonnet Joint; 2. Seat Tightness; 3. Packing Area. Although each area was treated separately, the relationship of one to the other was a factor that had a great deal to do with the outcome of the project.

A series of "torture" tests such as the pressure pulsator shown on the opposite page carried each part and joint to the point of destruction. Thus Edward designers were able to trace each weakness to its source. Perhaps no other valve ever designed has been known and understood so well by the men who designed it.

1. BODY SHELL AND BONNET JOINT. The valve bonnet was bolted finger tight; it tested at 2000 psi. Then, at full design tightness on all four bolts, the bonnet joint did not leak until 11,000 psi (5½ times design pressure!) was applied. Next, 8000 psi applied 100 consecutive times produced no apparent valve damage. Internal pressure was pulsated from 200 to 2000 psi for 10,000,000 cycles with no apparent damage!

The bonnet cap screws were subjected to 350% of design tightness before failure occurred. Further evidence of design effectiveness was the unpredictability of failure. In one case the threads stripped; in another the bolts broke off, and in other there was excessive bending of the bonnet flange. There was no *one* apparent point of weakness!

2. SEAT TIGHTNESS. Similar destructive tests were conducted on the valve stem and seat. The valve required on 65% of standard test closing torque to seal tight at 2000 psi. And 350% of standard torque was built up before the stem sheared below the handwheel. 100 operations at 2½ times standard torque did only negligible damage to seating surfaces. Even after this test only 90% of standard test torque was needed to hold 2000 psi.

3. PACKING AREA. Six times as much load as actually required to seal the packing chamber was applied to the gland bolts without causing damage. A load 3½ times greater than required for sealing was applied 50 times, also without causing damage.

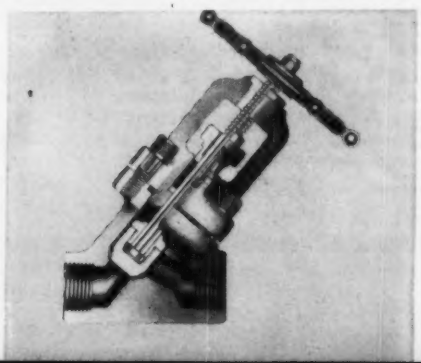
Thus the "perfect" globe valve was designed; perfect not because it can't fail, but perfect because it has no apparent weaknesses. The full design and construction story is told in Edward Catalog 14-G.

Edward builds a complete line of forged and cast steel valves from ¼" to 24" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1202 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

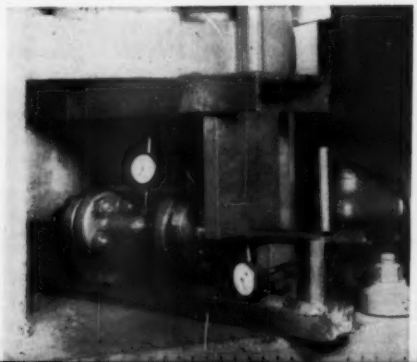
EDWARD STEEL VALVES
another fine product by
ROCKWELL

Chief Engineer C.A. Siver and **Design Engineer Don Easton** observe effects of pulsating pressure on newly designed Figure 848 forged steel globe valve in Rockwell-Edward Research Lab.

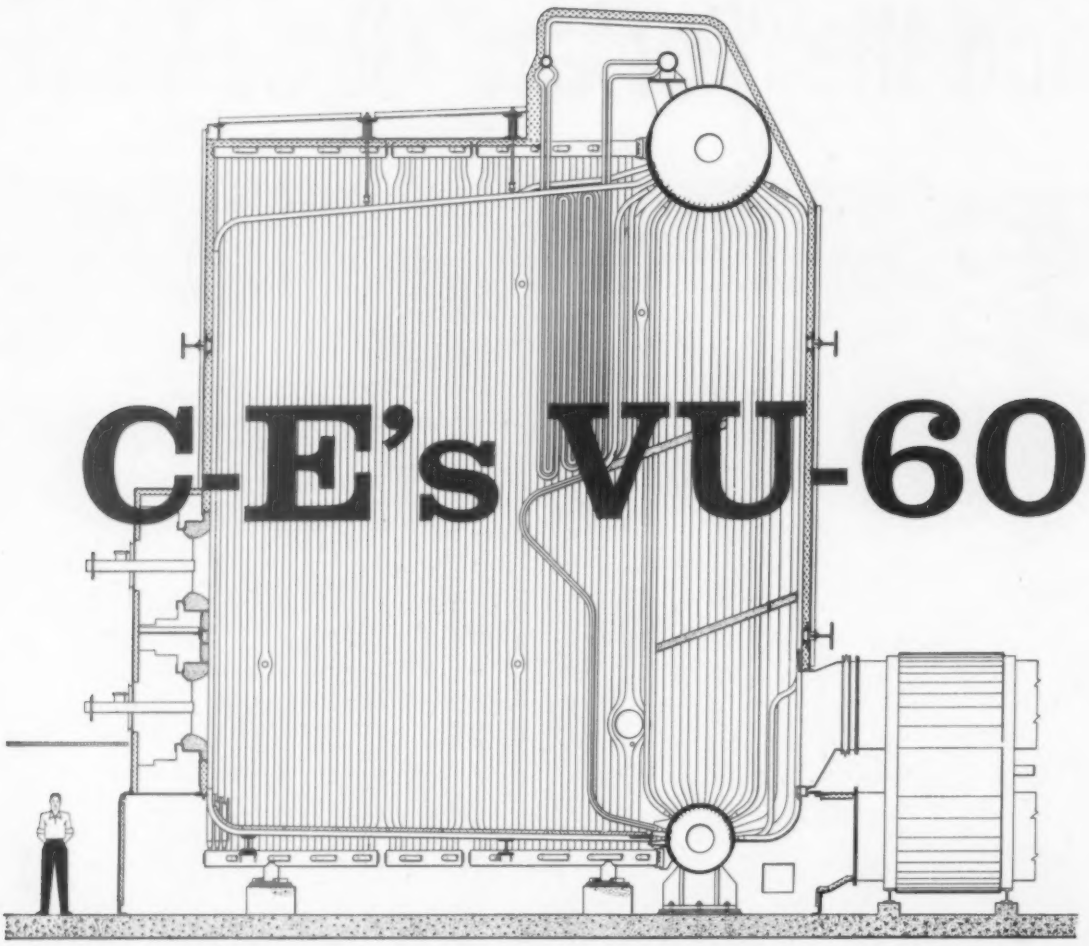
Rugged forged steel body . . . combined with high-strength stainless steel gland bolts and bonnet bolts, aluminum-bronze alloy yoke bushing, asbestos-stainless spiral gasket and other premium features . . . makes the Figure 848 a virtually "perfect" small steel valve.



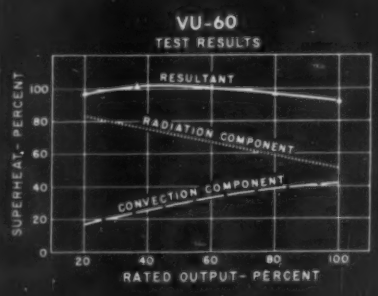
Test arrangement produces uniform bending moment on valve and ½" pipe. Test show that the strongest pipe likely to be attached to the valve will yield with less than ½ the bending moment required to distort body.



C-E's VU-60



SOME DESIGN HIGHLIGHTS OF THE VU-60



Modular increments allow assembly of custom designs from standardized components; boiler can be proportioned for best combustion, heat absorption, gas flow — even where space conditions are difficult.

Completely self-cased, the VU-60 is an all-welded pressure-tight envelope composed of modular panels of finned tubes; fewer field welds cut erection time.

Insulation and preformed lagging go directly over tube panels, thus reducing non-working weight per pound of steam generated.

Characteristic of Combustion's VU-60. This superheater curve indicates a temperature stability throughout entire load range.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER

GIVES YOU A CUSTOM-DESIGNED BOILER BASED ON STANDARDIZED MODULAR COMPONENTS

Because of its unique modular concept, C-E's new VU-60 offers unusual flexibility and can be designed to meet unusual or difficult space conditions.

VU-60 SPECIFICATIONS

Capacities:	100,000 to 250,000 lb per hr
Design pressures:	250, 500, 750, 1040 psi
Steam temperatures:	to 900F
Fuels:	Oil and/or gas
Firing:	Horizontal (front wall) or tangential
Size increments:	Depth-twelve Width-eight Height-three
Steam drum sizes:	Four

The VU-60 is a completely self-cased boiler. Finned tubes, shop-welded into modular panels, make up the exterior walls of the unit. The fins joining the panels are field-welded to make a pressure-tight envelope. Insulation is applied directly over these walls and is covered by pre-formed, field-installed metal lagging. The need for bulky or heavy nonworking structural members is kept to a minimum.

The VU-60 can be designed to meet your most exacting steam needs. It is easy to install, economical and dependable in operation, completely accessible and functional. Why not get full information on how this new concept can fulfill your specialized requirements?

COMBUSTION C-E **ENGINEERING**

General Offices: Windsor, Conn., New York Offices: 200 Madison Avenue, New York 16, N. Y.
Canada: Combustion Engineering-Superheater Ltd.

C-322

MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 510 on Post Card

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

WHY THE BIG STRAIN?

It's tough to keep gases and liquids "clean" as they run through a pipe. They drag impurities along, which can make even plain water a trouble maker, let alone more sophisticated fluids. That's because water, as a liquid or steam, is intimately involved with vital equipment like steam traps, temperature regulators, or tools. Meters, burners, nozzles, and pumps, too.

By this time you must realize we're going to talk strainers, don't you? A good, stout subject, of interest to all who feel production belongs up and costs belong down. Sarco makes strainers for water and condensate, steam, oil, air, gas and other piped fluids . . . dozens of different sizes and types and ratings of strainers to match every application need. Even our line of plain and simple strainers is built for super service. These are pipeline strainers, types AT, BT, and CT, which are designed for 250, 250 and 600 psi non shock, respectively, and 475°, 450° and 750°F. temperature ratings. Standard screens are heavy-gauge, perforated brass or stainless steel. Sarco specializes in screens that can withstand abnormal pressure differentials created by accumulated sediment.

Next, Sarco's flanged strainers, type D. These come in larger sizes, right up to 12", and are available in standard or extra heavy types.

And finally, *Sarco scraper strainers*, manual or motorized. These are the really eye-popping models, and if you can't use one yourself — well — you'll just have to get your kicks elsewhere.

Examples? Take Inland Steel Company at East Chicago, which gets water from Lake Michigan to cool its large air conditioner condensers. The water used to pass through traveling screens, but still contained fine sand. Clogging!

Heat under collars! Frequent cleaning required! Sometimes practically no air conditioning on hot days. (Isn't that always the way?)

The Inland Steel people installed Sarco Rotary Scraper Strainers, Type VRS, which incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. A few turns of the crank at regular intervals, and the sand is scraped off the screen, blown clear, and discharged at pressure through a manual valve to waste. Dismantle the strainer? Shut down the unit? Not *this* strainer!

Now, as long as we've come this far, it's only a hop and a skip to the Firestone Tire and Rubber Co. in Akron, Ohio, who also use water in tremendous quantities. They circulate it through tire presses and a cooling tower, and there's no nonsense about it. It *has* to be clean or damage to equipment could be downright catastrophic. When the plant

modernized and enlarged, Firestone replaced their 4" Sarco hand-operated scraper strainer, type VRS, with a larger Sarco 8" model. And while they were about it, they got the motor-operated type, for continuous cleaning.

When we say that companies like these want the insurance of a Sarco strainer, it sounds like advertisingese, but sometimes there just isn't any other way to put it. Sarco strainers *are* insurance at low cost on the operation of your high cost equipment. So when we ask if you have lumps in your pumps, or worries over your slurries, we're *serious*. We've heard everything in the straining line, so why not write us for literature and answers to those special problems you have.

A T-44 IS THE BEST POLICY

Sorry, but we can't leave the subject of insurance without bringing to your attention one of the best little insurance policies any company requiring cooling control could invest in. It's the *self-powered* Sarco T-44 Automatic Cooling Control. No compressed air or electricity is needed, but its advantages are best described in terms of three different plants of just one Sarco customer — Revere Copper and Brass, Inc.

Revere-Baltimore, Md., has cut water use 40 to 50% with T-44's. But in addition to former water waste, Revere had even more problems: possible wet air from uncontrolled cooling of compressor aftercoolers, plus sweating compressor cylinders; variations in viscosity of hydraulic oil and bearing oil; gas generator water waste; unreliability of manual shut-off of water supply when machines were down.

If your ears perk up in sympathy at mention of any of these problems, the results of Revere's cooling control program should bring you to full attention. One large compressor that had gulped 2400 gallons per hour now takes only 420 gallon sips. In addition all the problems itemized above were solved. T-44's are now used on their air compressors, gas generators, and hydraulic oil systems. At Revere-Riverside, Cal., water savings of 50% were experienced, and at Revere-Rome, N. Y., substantial savings were made too.

But after all, wasting water is only one way of wasting money, so let's go on to another matter of interest: the evils of manual control. When cooling water is controlled by hand the temptation to leave the valve nearly wide open is almost overpowering, in order to play it safe if the load varies. Result: overcooling, of course. And varying the flow runs the risk of undercooling. In either case, lowered process efficiency. Answer: The automatic Sarco T-44, which can't be tempted, is meticulously honest, unsentimental, and plain inhumanly practical when it comes to cooling control. You really ought to write for literature. T-44 is your best policy.

SPARE PARTS INSURANCE

As long as we're near the end, and still on this subject of insurance, may we graciously leave you with this valuable tip? No matter how closely a steam trap approaches perfection, some gremlin may cause it to act up. It's conceivable. So, keep on hand a parts list and spares of key parts for your steam traps and other system components. Parts are small and worth their weight in gold when you need them. A Sarco field engineer will make up a suggested list for you, if you tell us what components make up your system.

Might as well even keep a disc or two on hand for your Sarco Thermo-Dynamic Steam Traps, Type TD-50, even though they're so trouble-free our salesmen keep complaining about the lack of replacement parts business. We'll be glad to tell you about this unique steam trap in case you still don't know how miraculously simple and effective it is.

Pardon our monopolizing the conversation in this series of paid communiques, but we're trying our best to interest you in certain subjects that concern us both — to the point where you'll communicate.

5903

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

Pipeline Strainer
For more data circle 511 on Post Card

T-44 Cooling Control
For more data circle 512 on Post Card

Steam Trap, Type TD-50
For more data circle 513 on Post Card

Lined against corrosion with gunited concrete

The lining being applied – of corrosion-resistant concrete made with LUMNITE calcium-aluminate cement and insulating aggregate – will soon be protecting stack and breeching from the corrosive action of flue gas condensate.

It will also keep stack gases hot, maintaining better draft for greater operating efficiency. Steel shells will stay cooler, extending exterior paint life. And monolithic concrete linings have lower unit weight, reducing dead load on supporting structure. Gunited or plastered, installation is easy and economical, with the concrete reaching service strength in 24 hours. For convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready to use by adding only water.

For more information, write Universal Atlas, 100 Park Avenue, New York 17, N. Y.

Offices: Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee • Minneapolis • New York • Phila. • Pittsburgh • St. Louis • Waco

"USS," "ATLAS" AND "LUMNITE" ARE REGISTERED TRADEMARKS L-213

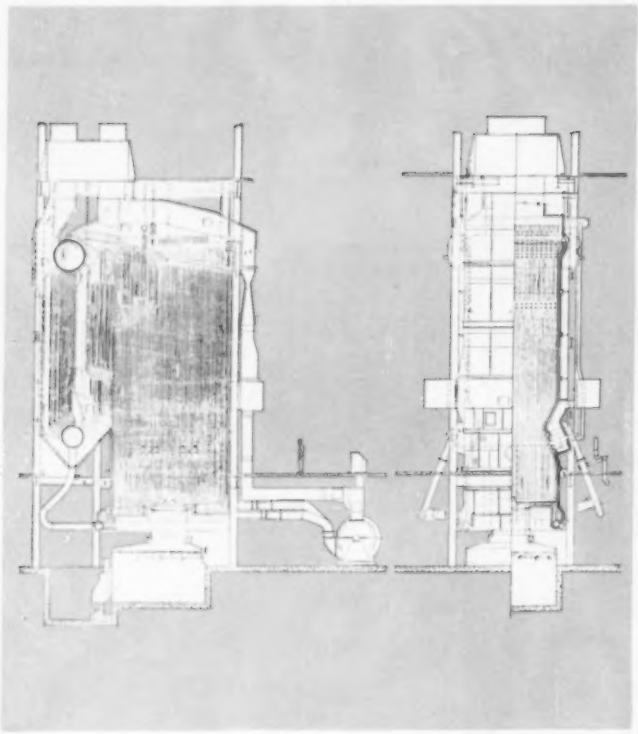
Universal Atlas Cement
Division of
United States Steel

USS

For more data circle 514 on Post Card

For the RIGHT Boiler and Firing Combination

Riley Stoker Corporation offers one of the broadest product lines in the boiler industry, particularly in cases where special boiler design and fuel burning arrangements

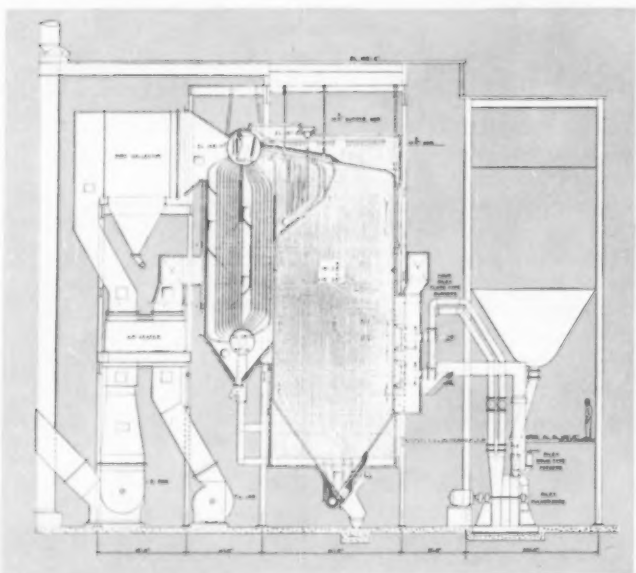


Opposed Firing In The Riley TURBO FURNACE Boiler With Riley Directional Flame Burners and Riley Pulverizers.

Electrical Equipment Manufacturer
Chicago, Illinois

Boiler Steam Capacity — 150,000 lbs/hr
Operating Pressure — 950 psig
Steam Temperature — 835 F.
Efficiency — 87.5%

The Turbo Furnace Boiler efficiently utilizes furnace waterwall surfaces providing rapid and uniform natural water and steam circulation. Uniform furnace gas distribution produces minimum variations in superheater temperatures. Almost entire absence of furnace wall deposits eliminates need for wall blowers. Carbon loss and flyash problems are kept to a minimum. The Turbo Furnace boiler can be fired by coal, oil or gas or any combination of the three and will maintain steam temperature over wide load ranges. The Turbo Furnace boiler with burners on one level arranged for opposed firing is easy to supervise and is well suited for automatic operation. This design is furnished in all capacities up to the largest central station reheat type units.



Furnace Wall Firing With Riley Flare Type Burners and Riley Pulverizers

Emery Industries, St. Bernard, Ohio

Boiler Steam Capacity — 200,000 lbs/hr
Operating Pressure — 350 psig
Steam Temperature — 550 F.
Efficiency — 87.3%

This Riley boiler design incorporates within its furnace wall circulation system the patented Riley Single Header Hopper which reduces overall height of structure and permits a higher capacity in a restricted area. By incorporating the hopper with the furnace expense of a separate hopper and its maintenance is eliminated. Riley Flare Type Burners used with this design burn coal, oil or gas separately or in combination. The design may be adapted to any steam capacity up to the largest central station reheat type unit.

For Complete Information About Riley Products Write—RILEY STOKER CORPORATION, WORCESTER, MASS.
Sales Offices: Boston, Charlotte, Chicago, Cincinnati, Cleveland, Denver, Detroit, Honolulu, Houston, Jacksonville, Kansas City, Los Angeles, Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, St. Louis, St. Paul, Seattle, Syracuse.

BUY RILEY ALL THE WAY!

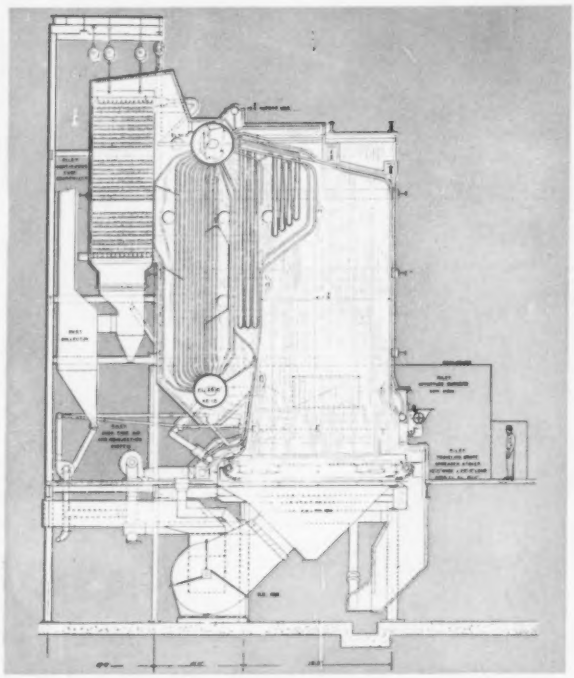
are required. When you buy a Riley Boiler complete with Riley Fuel Burning Equipment, you do so under a single contract with undivided responsibility

Spreader Stoker Firing With Riley Traveling Grate and Model "D" Feeders

Deere & Company, Moline, Illinois

Boiler Steam Capacity — 135,000 lbs/hr
Operating Pressure — 650 psig
Steam Temperature — 750 F.
Traveling Grate — 16′ x 20′
Efficiency — 87%

Unusual here is that this is the first successful application of pressure firing with a spreader stoker. The unit is also provided with Riley Intertube Gas Burners. The Riley Spreader Stoker is used extensively to burn a wide range of bituminous coals, lignite, wood refuse, bagasse and other cellulose materials. Riley Spreader Stokers are being supplied for steam capacities as high as 650,000 lbs/hr and are also available with stationary and oscillating grates.

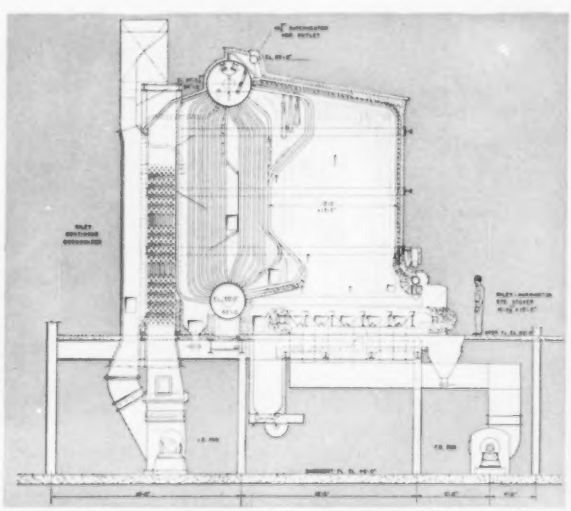


Overfeed Firing With Riley Harrington Traveling Grate

Owens-Illinois Glass Co., Bridgeton, New Jersey

Boiler Steam Capacity — 70,000 lbs/hr
Operating Pressure — 200 psig
Steam Temperature — 460 F.
Stoker is 13′ wide by 15′ 2½″ long
Efficiency — 84.4%

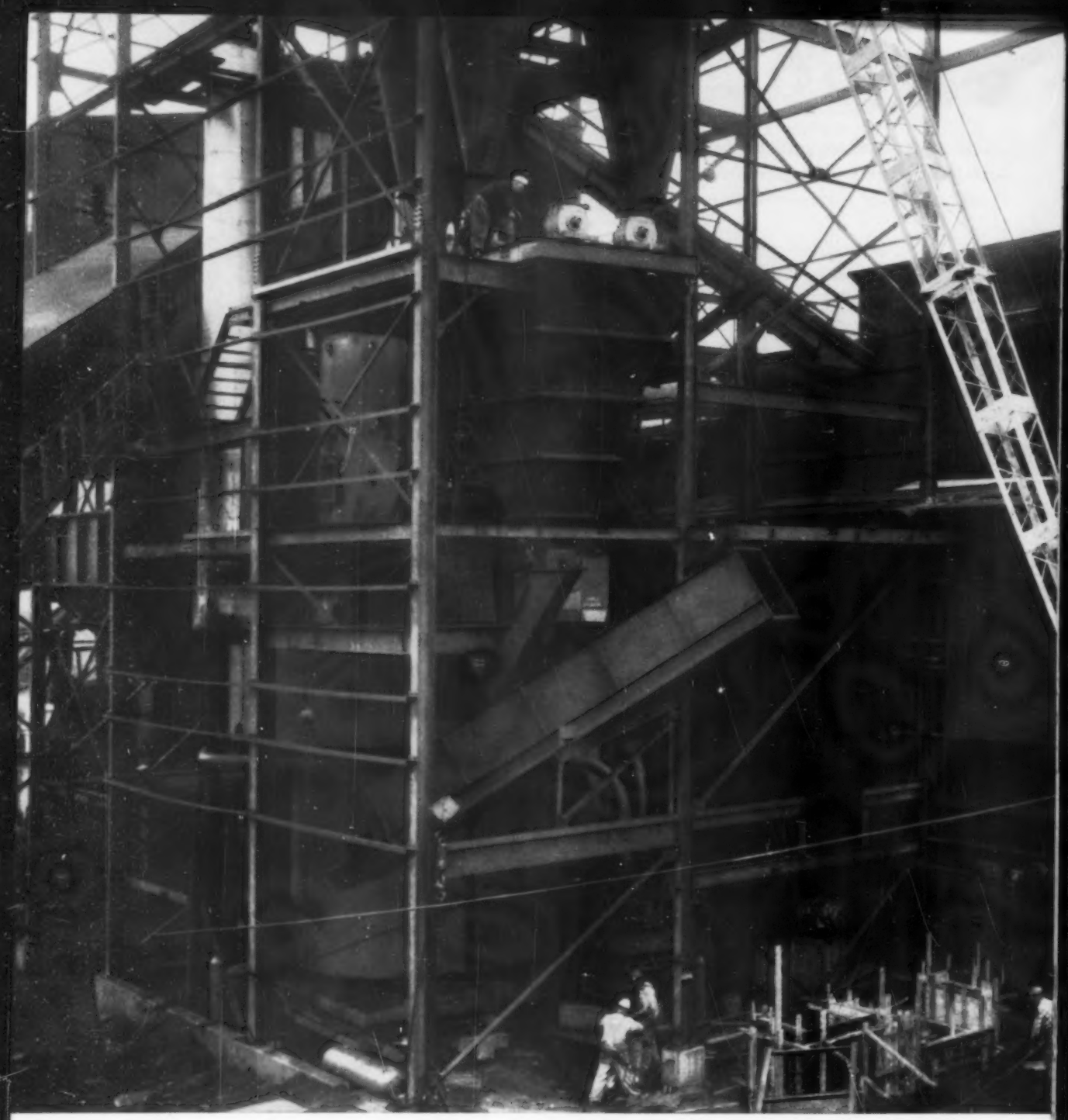
The Riley-Harrington Traveling Grate Stoker efficiently utilizes fuels that have a wide range of coking, caking and ash fusion characteristics; also low grade fuels such as coke breeze, sub-bituminous and fine sizes of anthracite coals and lignite. Normally used with boilers from 50,000 to 250,000 lbs/hr capacities. Recent successful adaptions of Riley-Harrington stokers are for metallurgical coke production and incinerators.



A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

For more data circle 515 on Post Card



Progress Report: *Eastern's new cleaning plant at* ***Federal No. 1 mine, Grant Town***

ON SCHEDULE

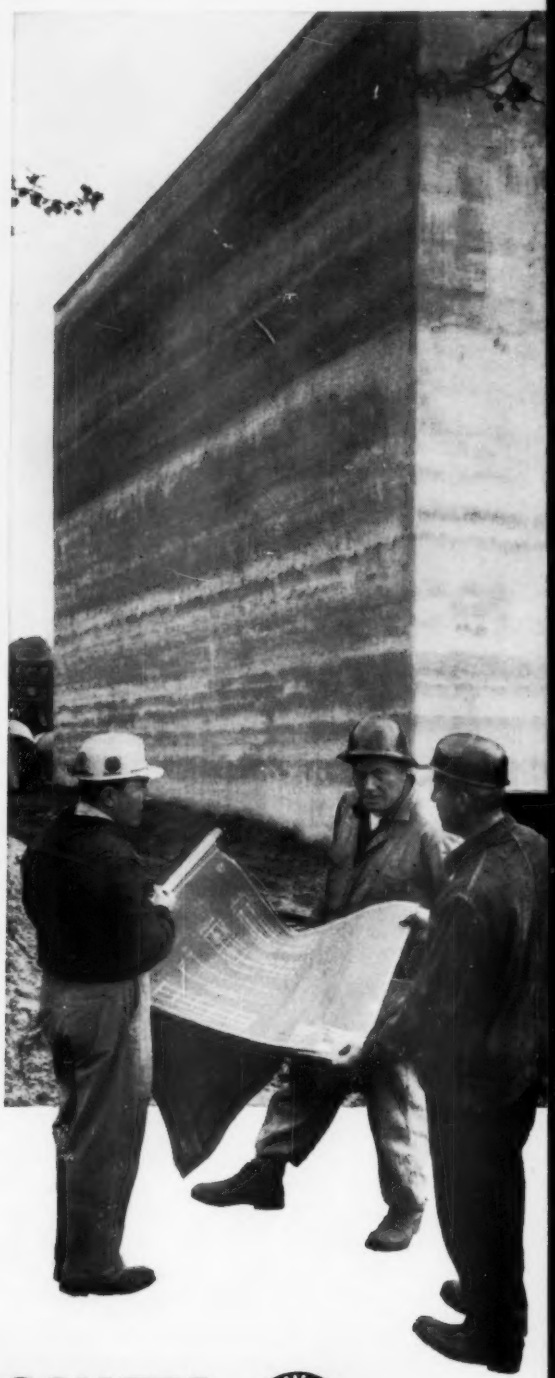
The construction of the new coal cleaning plant at Eastern's Federal No. 1 mine, Grant Town, W.Va., is proceeding on schedule.

Designed by Eastern's own engineering staff, the new plant will employ the most modern equipment, so arranged as to provide uninterrupted production at all times. This plant will produce a very high grade of steam coal.

For more data circle 516 on Post Card

(Left) Main plant showing the dryer at left, pulverizer (at base of dryer) and part of the dust collector system.

(Below) Company and contractor personnel check progress of 2500 ton capacity blending bin adjacent to main plant.



Federal No. 1 is one of a series of such cleaning plants now under construction or in the planning stage. These plants are evidence of Eastern's determination to continually improve their product and their service to customers.

If you would like a full description of the facilities at Federal No. 1, write or phone your nearest Eastern representative.

EASTERN GAS AND FUEL ASSOCIATES

BOSTON • CINCINNATI • CLEVELAND • DETROIT • NEW YORK
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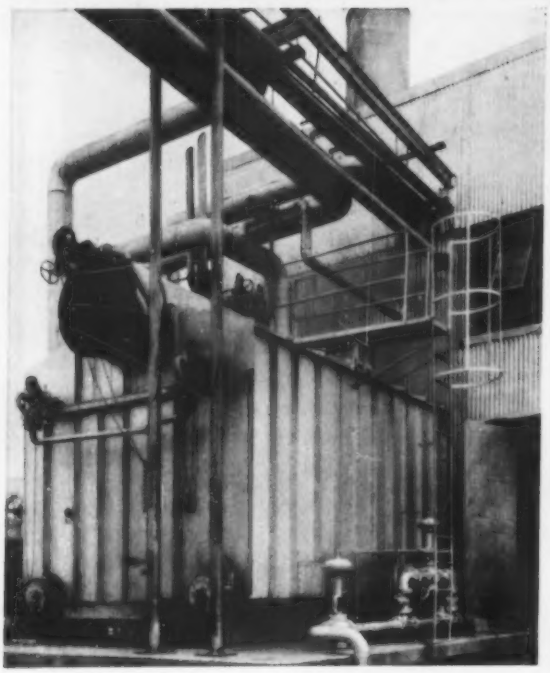
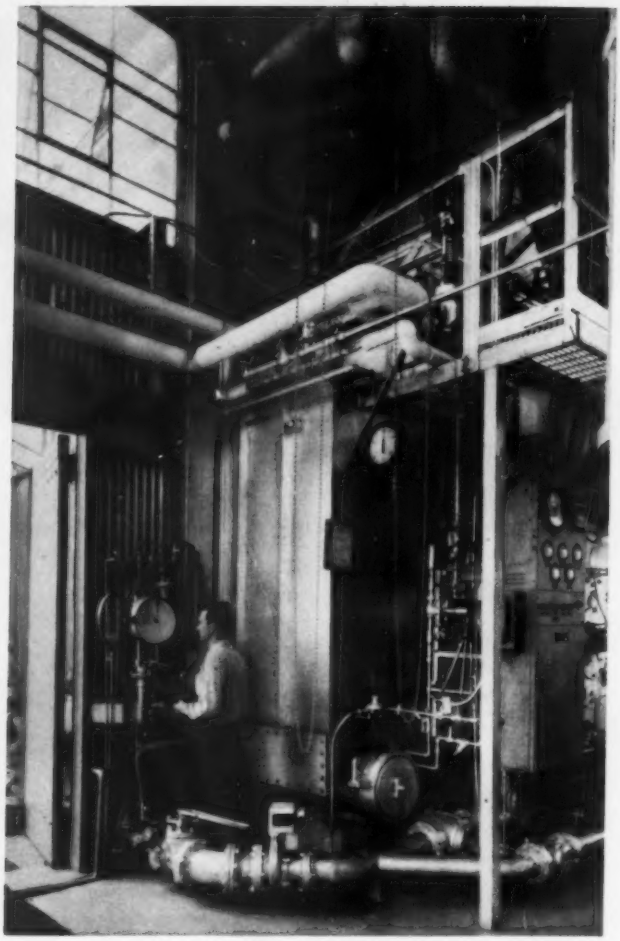
EASTERN GAS AND FUEL ASSOCIATES
BEACON COAL

Processing wallboard at Kaiser Gypsum





Union Packaged Boiler takes increased load in stride

A good part of the steam for processing gypsum wallboard at Kaiser Gypsum Company's Long Beach plant is supplied by the Union Type MH Packaged Boiler shown.

Semi-automatic fired with a normal operating pressure of 200 psi, this compact unit went on the job in 1956. Installed outdoors, it eliminated the need for further extension of the existing boiler house.

Although originally furnished to deliver steam for 2 out of 5 zones in a Coe Dryer, the MH was later hooked up to carry more of the load handled by an older boiler. Says the engineer-constructor, Kaiser Engineers: "The extra load demand on the Union Boiler was hardly noticeable from an operating standpoint."

Throughout industry, similar reports verify reliable Union performance on stiff assignments. Job-proved designs, complete shop assembly, compactness, easy installation and above average efficiency combine to make Union MH Steam Generators the best dollar-for-dollar buy on the market.

Readily equipped to handle a great diversity of needs formerly requiring costly field erection and special engineering, Union Packaged Steam Generators are now operating at capacities over 100,000 lbs./hr.

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA
A DIVISION OF RILEY STOKER CORP.

For more data circle 517 on Post Card

Hall Industrial Water Report

VOLUME 9 AUGUST 1961 NUMBER 2

Ring around a rosy

The steel manufacturer uses tremendously expensive equipment and goes through many elaborate operations to convert iron ore into steel. Then, as soon as he has produced this important product, nature begins to change it right back into iron oxide. When water is involved, it is surprising how fast this "Ring Around a Rosy" can proceed unless the water is properly treated to control corrosion.

Hall Engineers are well fitted by training and experience to tackle corrosion in boilers, cooling systems, and industrial piping and equipment where water contacts metal—nonferrous metals and alloys as well as steel. Why not let them help you with your corrosion problems?

Trouble ironed out

Only three weeks after a paper mill started operation of a new boiler at high pressure, a tube failed and several others were damaged by overheating. This was hard to understand, since boiler feedwater was composed equally of condensate and demineralized makeup.

The cause was found to be iron oxide deposits. Searching for the source of the iron oxide, Hall field engineer R. P. Sterner discovered that the condensate was picking up as much as 500 ppb iron from the surfaces it contacted.

Sterner recommended feeding filming amine (Hagafilm®) to the boiler feedwater. This was supplemented temporarily by feeding additional amine to the steam at paper machines which were discharging badly contaminated condensate. This condensate was discarded for a short time until iron concentration dropped to tolerable values.

After one month, iron content of the condensate was about one-fifth of the original concentration. After five months there was a further substantial drop and the boiler was found to be clean. Freedom from iron oxide accumulation in the boiler has continued.

Talk about corrosion

This pump impeller circulated calcium chloride brine in a refrigerating system. But not for long—the old wrecker "corrosion" saw to that.

A new impeller is still going strong after several years. Use of sodium chromate as an inhibitor and upward adjustment of alkalinity in the brine has stopped corrosion cold.

Dissimilar metals

When he started water conditioning service in an electrical equipment plant, one of the first problems Hall filed engineer, W. E. Hughes, had to tackle was stoppage of cooling water flow in radio frequency generators, a serious situation.

A quick survey revealed that while the main cooling system piping was steel, the run-outs to the generators and the cooling loops in the machines were copper. Furthermore, the inlet and outlet bushings at the machines were steel. These bushings quickly became plugged with iron oxide deposits.

Hughes recommended the replacement of steel bushings with copper to eliminate bimetallic contact as far as possible. He then instituted chemical treatment with a special metaphosphate (Calgon® TG) and slimicide to control corrosion and deposit formation. These steps were so effective that there have been no more interruptions in cooling water flow.

Heating system leaks avoided

A large eastern school has two iron and steel hot water heating systems. One loop serves wall radiators with 180°F water and the other circulates 120°F water through coils embedded in concrete floors.

When the Hall field engineer checked water samples, he found low pH values and high iron concentrations—indications of severe corrosion. Also, corrosion products were interfering with heating efficiency.

First, the systems were flushed to remove loose deposits. Then a borax-sodium nitrite product (Hagan Corrosion Inhibitor CS) was added to the circulating hot water. Now the water is practically iron free and corrosion is being controlled.

All the students and teachers know is that now there is floor heat in some rooms that were not previously getting it.

Want more information?

The many ways industry can use Hall Laboratories industrial water consulting services are described in a 24-page brochure.

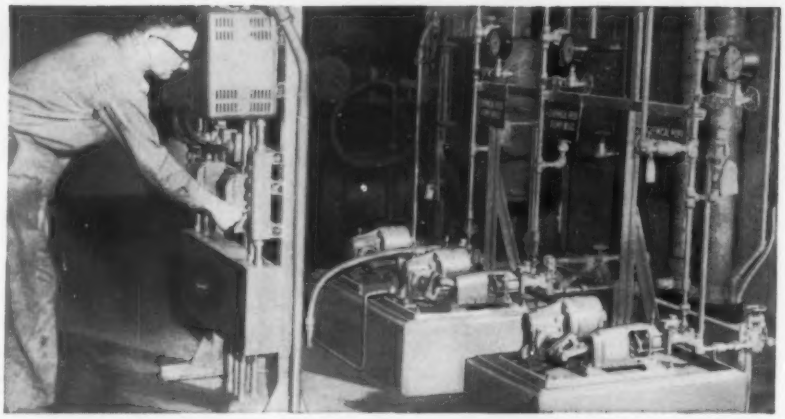
For your copy, write on your letterhead to:

HALL LABORATORIES
HAGAN CENTER, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
For more data circle 518 on Post Card

how to select the right metering pump for water treatment

SOFTENING, demineralizing, pH control, oxygen scavenging . . . all of the treatments commonly applied to water place special demands on chemical feed systems. Chemicals must be metered to a high degree of accuracy, but many of them, particularly the strong acids and alkalies, are themselves highly corrosive. Through the years, controlled volume pumps have proved the ideal metering technique in this field, combining accuracy, controllability, and corrosion resistance. But the question often arises, "Which controlled volume pump design is best for my water treatment needs?" Here are a few practical suggestions based on actual experience.



Standard Milton Roy MD pumps meter ammonium hydroxide to maintain desired boiler feedwater pH at Ohio Power Company. Milton Roy miniPumps also feed minute amounts of hydrazine to remove residual oxygen from feedwater at this generating station.

PUMP SELECTION GUIDE

FOR	USE THIS PUMP TYPE
Coagulation	
alum	MD
silicate	MD
Demineralization	
acid regeneration	Diaphragm / Mersemetric
alkali regeneration	Diaphragm
Softening	
conc. phosphoric acid	Diaphragm
conc. sulfuric acid	Diaphragm / Mersemetric
lime slurries	MD
phosphates	MD / H20
soda ash solution	MD
Oxygen Scavenging (Boiler Water)	
sodium sulfite	MD / H20
hydrazine	MD / miniPump
Calcium Precipitation (Boiler Water)	
phosphates	MD / H20
Carbon Dioxide (Boiler Water)	
neutralizing amines	MD / H20
filming amines	MD / H20
pH Control (Boiler Water, Process Water, Cooling Towers)	
caustic soda	Diaphragm / Mersemetric
sulfuric acid	Diaphragm / Mersemetric

Packed plunger pumps . . . MD, H20®, miniPump®

The standard Milton Roy MD pump is usually the first choice for metering water treatment chemicals. Highly accurate, its capacity is readily varied manually or automatically in response to treatment demands. A wide variety of materials of construction from cast iron to stainless steel withstand all mildly corrosive treatment chemicals. Capacities to 2056 gph, pressures to 1000 psi. *Bulletin 553-1.*

Non-corrosive chemicals can be metered economically with the H20 pump if constant speed operation is satisfactory. Though it cannot be adjusted in operation, this low cost pump is ideal for feed to packaged boilers. Capacities to 28 gph, pressures to 600 psi. *Bulletin 558-3.*

When extremely small volumes of chemical, from 20 to 2940 milliliters per hour, must be metered to accuracies of 1%, the Milton Roy miniPump is the right answer. That's why this design is just about standard for metering hydrazine in oxygen scavenging. Pressures to 1000 psi. *Bulletin 1257-2.*

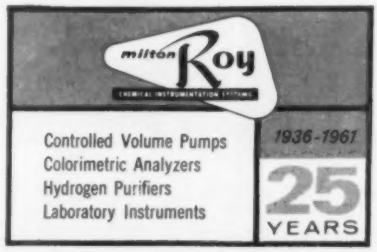
Diaphragm liquid ends

The best pump for highly corrosive or otherwise dangerous treatment chemicals is the diaphragm pump, with a stainless steel or plastic diaphragm isolating the plunger from the treatment chemical. Positive air purging at each stroke eliminates any chance of air binding. And the diaphragm liquid end is readily interchangeable with the packed plunger liquid end of the standard MD pump, permitting economical modernization in the event of a change in metering requirements. Capacities to 400 gph, pressures to 2700 psi. *Bulletin 1157-2.*

Totally immersed liquid ends . . . Mersemetric®

Many special metering problems are easily solved by Mersemetric controlled volume pumps with the liquid end submerged to a depth of up to fourteen feet. Chemicals can be metered directly from storage tanks without any need for tank connections below liquid level. Mersemetric pumps are widely used to feed sulfuric acid to cooling tower water and deaerator effluent, and sulfuric acid or caustic soda for demineralizer regeneration. Capacities to 218 gph, pressures to 1200 psi. *Bulletin 1153C.*

If precision pumping of boiler water treatment chemicals is one of your problems, look again to Milton Roy's 25 years of experience for your most economical solution. Milton Roy Company, 1300 East Mermaid Lane, Philadelphia 18, Pennsylvania.



For more data circle 519 on Post Card

Current Catalogs

Valves and Fittings

101 Valve Selector — Sixteen-pp Catalog 10-B of R-P & C Valve Div., American Chain & Cable Co., Inc., contains specification data on bronze, iron body and cast steel gate, globe and angle, and check valves, bar stock valves and forged steel gate valves.

102 Improved Butterfly Valves—Details on butterfly valves with adjustable rubber seat feature for varied requirements are presented in Bulletin 6 of The Henry Pratt Co. Data tables included.

103 Renewable Seat Valves — Details on a ring gate valve which need not be removed from the line to replace seat rings are presented in Circular V126 of The Fairbanks Co.

104 Level Gage Valves—Two product catalogs—Data Units 397 and 398—illustrate and describe features and construction details of Jerguson Gage & Valve Co's union bonnet and screwed bonnet liquid level gage valves. Roughing-in drawings and data included.

105 Air-Operated Valves — Details on air-operated diaphragm valves for remote and automatic flow control of corrosive and non-corrosive liquids and gases are presented by Hills-McCanna Co. in 6-pp Bulletin 134-A. Tables of air actuator pressures for various line pressures included.

106 For High-Pressure Fluids—Lubricated plug valves which utilize a ball bearing system to handle high-pressure line thrust on the plug are featured in this 16-pp bulletin of Walworth Co., along with selection data.

107 Spherical Plug Valve—Principle of operation and advantages of non-lubricated low torque valve are detailed in this data bulletin by Pittsburgh Brass Mfg. Co.

108 Valve Flow Characteristics—Pressure drop factors in lubrication plug valve specification are covered in this 12-pp bulletin by Walworth Co. Methods of computing pressure drop are given with tables.

109 High-Vacuum Equipment—Valves, baffles and traps designed for high-vacuum applications are featured in 28-pp Bulletin 10-1 of Consolidated Vacuum Corp. Design and construction details are illustrated and selection tables included.

110 Breather Valves—Three-in-one breather valves offering a choice of diaphragm, air cushion or metal-to-metal pallet design are featured in 12-pp Bulletin CP2701 by The Vapor Recovery Systems Co. Design data and leakage and flow curves included.

111 Simplified Sealing — Eight-pp Bulletin WB-1 tells how, when and why to use a V-band coupling. Prepared by Aeroquip Corp., bulletin explains how fastening of coupling can improve design, appearance, reduce assembly time and costs. Illustrates coupling and flange configurations, explains sealing principle.

112 Guide to Strainers—Semi-steel, bronze, cast steel and stainless steel strainers — screwed and flanged Y pattern and basket type—are featured in 20-pp Catalog 61 of O. C. Keckley Co. Information includes working pressure (non-shock), recommended service, construction features, standard screens furnished and available, dimensions and shipping weights of each style.

Pumps, Pumping

113 On Rotary Pumps — Performance and construction details on rotary pumps designed to handle thick or thin liquids and operate in either direction with equal efficiency are presented in this 16-pp bulletin of Roper Hydraulics, Inc. Dimension charts included.

114 Chemical Pumps — Cradle-mounted chemical pumps featuring interchangeability of parts among various sizes are described in 8-pp Bulletin 70288 by Ingersoll-Rand Co. Dimensional data, diagrams, and coverage chart included.

Electrical

115 Shutdown Master Planner—This wall chart from Westinghouse Electric Corp. facilitates scheduling of equipment shutdown maintenance activities. Items involved in the shutdown are shown at a glance, and space is provided for listing time and manpower requirements.

116 Pump Motors, Drives — Condensed specification data on pump motors and drives, as well as selection tables giving ratings, dimensions, thrust capacities in pounds, speeds, frame sizes, ratios and electrical specifications are presented by U.S. Electrical Motors Inc. in 20pp Bulletin F-2002.

117 High-Speed Grounding Switch—Bulletin PPSE-110 contains specifications, application information, design and operating details on high-speed grounding switches of Line Material Industries, McGraw-Edison Co.

118 Miniature Push Buttons—Twelve-pp Bulletin GEA-7127A contains selection data on latest additions to General Electric Co's industrial, miniature, oil-tight push buttons. Describes wide range of miniature forms for every requirement.

119 Distribution System — Safety-engineered distribution system to supply power to electrical resistance strip heaters for preheat and stress relief in welding covered in Data Sheet SH-102-D, J. B. Nottingham & Co., Inc.

120 Transite Electrical Conduit — Described in 12-pp Bulletin TR-247A, by Johns-Manville Corp., are two types of transite electrical conduit; a thin-walled, asbestos-cement conduit for installation in concrete and a thicker-walled conduit for direct burial. Table lists conduit requirements, properties, performance factors.

121 High-Voltage Testing — Bulletin 5-15.4 by Associated Research, Inc. tells how high voltage testing can be nondestructive. Covers causes of insulation breakdown, the minimizing of destructiveness by current limiting and other aspects of insulation testing.

122 Lightning Arrestors—Distribution-class, valve-type lightning arresters for transformer, capacitor bank and underground distribution protection are described by McGraw-Edison Co. in 12-pp Bulletin LA2. Protective characteristic charts included.

123 Line Stringing Equipment—Detailed information on tension wire stringing equipment and line construction equipment and accessories is presented in 34-pp Catalog TSE-1 by Petersen Engineering Co., Inc. Covers cable pullers, tensioners, reel stands, winders and carriers.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 91 and 92.

124 For Electrical Insulation—Eight-pp Bulletin CDS-288, General Electric Co., features silicone varnishes for impregnating and protective coatings, clear and opaque potting and encapsulating materials, dielectric fluids, dielectric greases, wire and cable insulation and combination constructions of silicones with other materials.

Mechanical Power Transmission

125 Spiral Bevel Reducers — Horizontal and vertical spiral bevel speed reducers are described by Hewitt-Robins in 34-pp Bulletin J-25. Gives information on basic types, features of vertical types, applications, selection, overhung and thrust load capacities, standard assemblies, ratings, dimensions, and bedplate dimensions.

126 Mechanical Power Transmission — Eight-pp Bulletin 23103 by T. B. Wood's Sons Co. describes mechanical power transmission equipment, including V-belts, variable speed and timing belt drives, flat belt pulleys, motor bases, flexible couplings, bushings, bearings, pillow blocks and related equipment.

127 Stronger Pulleys, Hubs—Curve Crown pulleys with spun end construction are described by Stephens-Adamson Mfg. Co. in Bulletin 1160, also Squeeze Lock hub which exerts equal force in two directions. Pulley load rating, dimensions and weights, and comparison of competitive pulleys are all tabulated.

128 Ball Bearing Pillow Blocks—Heavy duty ball bearing blocks equipped with self-aligning, single row, deep-groove precision ball bearings are featured by Link-Belt Co. in Folder 2951. Interchangeability chart included.

Instruments, Controls

129 Intsruments and Controls — Illustrated and described in Bulletin G14-1, by Bailey Meter Co., are fluid meters for recording, indicating and integrating; transmitters and recorders for pressure and draft; level transmitters; and temperature instruments, as well as plug-in components, analysis instruments, and analog and digital systems.

130 Pressure, Vacuum Gages — Instruments for measuring, indicating, recording and controlling pressure and vacuums in industrial processes are featured in 32-pp Catalog C 70-1a of Minneapolis-Honeywell Regulator Co. Specifications and data on instrument types and control systems included.

131 Pneumatic Receiver — Six-pp. Bulletin A134 of The Bristol Co. covers features and advantages of a pneumatic receiver with 4-in. chart width, for versatility and ease of operation.

132 Compensating Level Instrument —Specification Sheet M31-2 describes Bailey Meter Co's level recorder or indicator which measures true boiler drum water level by compensating for changes in specific weight.

133 Visual Instruments—Electronic equipment of Streeter-Amet Co. showing weights on easy-to-read direct reading dials for use where printed weights are not required are featured in Bulletin 658-B2.

134 For Liquid Metering — Illustrated and described in 20-pp Catalog P-100, Rockwell Mfg. Co., are Rotocycle meters designed for metering any liquid from solvents or LPG to heavy crudes. Explains Rotocycle principle and gives dimensions, specifications.

135 Variable Area Meters—In 20-pp Catalog 520.100, Wallace & Tiernan Inc., presents glass-tube type Vareameters, giving information on applications, features and details of several tube and float types. Provides selection and ordering data and illustrates available accessories.

136 Self-Balancing Indicators—Operating principles and advantages of self-balancing indicators and indicating controllers, potentiometer and bridge types, are detailed by Thermo Electric Co., Inc. in Bulletin 67.

137 For Checking Pressure Instruments — Eight-pp Bulletin 363 describes test gages and gage testing equipment, including master reference gages, dead weight testers and test pumps, pocket and vacuum test gages, others manufactured by Manning, Maxwell & Moore, Inc.

138 Control for Air Conditioning—Operation and suggested applications for air conditioning method controlling humidity to 1 per cent RH and temperature to 1 F is described by Niagara Blower Co. in Bulletin 122, 8-pp. Range is zero to 140 F.

139 Digital Draw Indicator—Operating details and advantages of Dynapar digital draw indicators for draw or speed measurement on paper machines are covered in Bulletin 203 by The Louis Allis Co.

140 Recorder-Annunciator — Operation details and specifications on Keinath Instrument Co.'s multiple recorder-annunciator which records 10 to 400 variables on one sheet of paper are presented in this 8-pp bulletin.

141 Annunciator System — Design and selection data on a flexible annunciator system designed to provide automatic reset, locked-in and ring-back annunciation sequence for all variations of supervision are presented in 8-pp Bulletin 204, Electro-Mech Corp.

Dust and Fume Control

142 Electronic Air Cleaner—Principle of electronic precipitation is explained in 16-pp Bulletin 258B by American Air Filter Co., Inc. Specifications, dimensional diagrams and tables of capacities are included.

143 Impingement Gas Scrubber — Catalog 150 of The W. W. Sly Mfg. Co. tells how impingement baffle plate design of this gas scrubber contributes to cleaning efficiency with minimum power and liquid consumption.

Materials Handling

144 Materials Handling Equipment —Twelve-pp Bulletin G-3E describes Fuller Co.'s rotary compressors and vacuum pumps; horizontal-grate material coolers; preheaters — suspension type; Airveyor and Airslide conveying systems for handling dry, pulverized, granular and crushed materials.

145 Utility Tractor Equipment — Features and specifications of Allis-Chalmers crawler and wheel utility tractor equipment with attachments are listed in 6-pp illustrated Specification Sheet UT-142.

146 Ball Bearing Idlers — Design and dimensional details on medium-duty ball-bearing belt conveyor rolls, both troughing and return idlers, are presented by Webster Mfg., Inc. in Bulletin 456-10.

147 Belt Conveyor Idlers—Troughing and return idlers for belt conveyors are featured in Bulletin 100 of The Hughes-Tyler Mfg. Co. Dimension and capacity tables included.

Boilers, Auxiliaries

148 For Heat, Power, Process — Superior Combustion Industries, Inc., features package steam boilers in Bulletin 2169D. Types CC, CF, CT, AS and D are covered, with dimensions, data, capacities, and features.

149 Package Steam Generators — Design and construction details on two-drum water tube boliers for oil or gas firing are presented by Erie City Iron Works in 16-pp Catalog SB-63. Fold-out pages of data and specifications included.

150 Pressure Vessel Code — This handy wall chart prepared by Missouri Boiler and Tank Co. illustrates types of pressure vessel construction provided for under ASME boiler and pressure vessel code.

When ordering catalogs, allow time for us to relay your requests to the manufacturers — and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

151 Feedwater Heater Tube—Mechanical and physical properties of Cupro Nickel heat exchanger tube designed for use in power plant feedwater heaters are detailed in Bulletin DM-6104 by The Anaconda Co.

Other Equipment

152 Solid-Wheel Turbines — Principle of operation and advantages of solid-wheel turbines designed to operate with minimum maintenance are detailed in 16-pp Bulletin S-159 by The Terry Steam Turbine Co. Dimensional data included.

153 Centifugal Fans — Operating features, construciton details and engineering data on industrial airfoil centrifugal fans for heavy duty applications are presented by Westinghouse Electric Corp. in Catalog 1122.

154 Engineering Know-How — "Background and Experience," a 24-pp handbook, touches upon services of Stone & Webster Corp. in design and construction of complex projects and in consulting work. Discusses activities in electric power and transmission systems, nuclear power, dams and hydro plants, industrial plants, gas work, de-

VERTICAL DESIGN

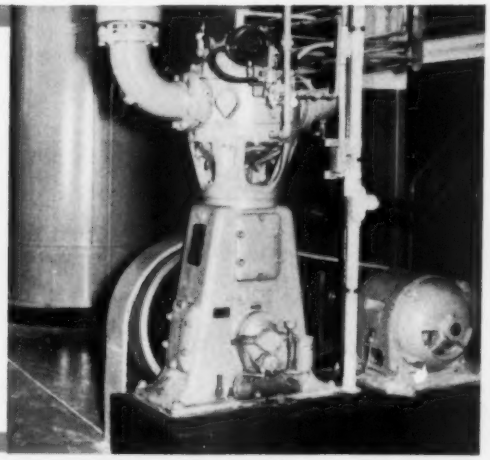
gives you oil-free air
with low maintenance

JOY WGO-9 Compressors

Because the Joy WGO-9 oil-free compressor is designed vertically, carbon ring wear is greatly reduced. Equal pressure on all sides of the piston rings produces even wear and reduced maintenance. The piston need never be rotated.

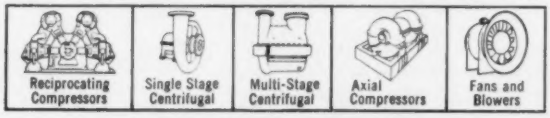
All Joy oil-free compressors are equipped with carbon graphite piston rings of an exclusive T-block design. They require no lubrication and compensate automatically for wear so that blow-by is virtually eliminated for the life of the ring. Joy compressor owners report ring life of 8000 operating hours or more.

WGO-9 compressors are available from 95 to 1528 cfm, 15 to 150 hp. Joy also builds complete lines of larger oil-free units including centrifugal and axial types as large as 15,000 hp. For complete information on the WGO-9 write for bulletin 2415-56C.



This WGO-9 supplies oil-free air for instruments and controls at a large central station powerhouse of a mid-western utility.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

For more Data circle 520 on Post Card

Quiet, Efficient, Convenient

Ideal for Hospitals, Hotels, Apartments, and Industries where noise is objectionable.

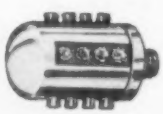
Rotojet Electric Tube Cleaner thoroughly cleans straight tubes from 25/32" to 4" I.D. in boilers, condensers, evaporators, and heat exchangers so quietly that it can be operated without disturbing anyone.

This self-contained unit comprises a powerful motor, rotatably mounted on a stand, a required length of heavy duty flexible shaft, a 20 ft. cable, and a selection of heads, brushes, drills, and scrapers to meet any cleaning need. The motor swivels and rotates so that tubes on top, bottom, and sides can be cleaned without moving the unit. A few of the many types of heads available are shown below.

Bulletin 107 gives full details of this quiet, efficient, convenient tube cleaner. Send for it now.

Rotojet Electric Tube Cleaner with swing-frame head.

4-way drill and universal coupling.



Expanding wire brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
1071-47 BRISTOL ROAD, MOUNTAINSIDE, N. J.

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fense projects etc., foreign work. Also covers engineering reports, appraisals.

155 Power Lube Systems—Centralized lubrication equipment is featured in Catalog 82, 32-pp, of Lincoln Engineering Co. Automatic, semi-automatic and manual equipment, high and low pressure injectors, timing and alarm controls, filler pumps are detailed with installation accessories.

156 Flame Spraying Applications—Included in this data bulletin by Metco Inc. are case histories of 17 flame spraying applications in electric power generation stations. The cover use on boiler feed pump castings, furnace parts, pump sleeves, circulating water pumps, valve rods, piston rods.

157 Jet Blowers, Nozzles — Operation and performance of steam jet blowers using pressure steam or compressed air for ventilating and circulating applicatons, and blast nozzles for low drafts in ducts and stacks is dedescribed in Bulletin 4AB, 8-pp, of Schutte and Koerting Co. Dimensions, weights, capacities are given.

158 Fluid Power Cylinders—Design features and advantages of air and hydraulic power cylinders manufactured by Miller Fluid Power Div., Flick-Reedy Corp. are explained in 24-pp Bulletin P2546P. Selection tables are included for air cylinders, hydraulic cylinders, accumulators, hydraulically controlled air power units, boosters, and pipe thread fittings.

159 On Blending of Coal — Offered in "It's A Fact," by B-I-F Industries, is an economical solution to the problem of blending high and low volatile coals to prevent excessive expansion in coke ovens. Booklet, comprised of data sheet and bulletins, stresses advantages of blending by weight and features Conveyflor Meter, Series 550.

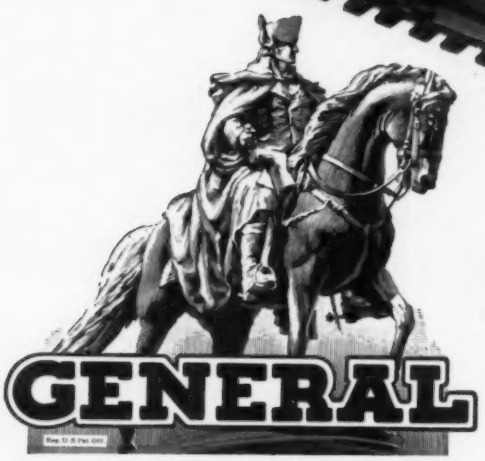
160 Special Lighting Units — Folio 61-1, 12-pp, describes cast aluminum special purpose lighting units offered by McPhilben Lighting, Inc. Applications for vaportight, exterior, interior use and directional signs are covered with specifications, drawings and optional features.

161 Flexible Metal Hose—Included in 32-pp catalog 600 by Atlantic Metal Hose Co. is information on how to rate hose working pressures so that corrections can be made for job conditions. Covers problems of nonsteady pressures, elevated temperatures, choice of fittings.

162 Tank Heaters—Eight-pp Bulletin 1623, The Griscom-Russell Co., on vertical and horizontal tank heaters tells how to determine number of heaters needed for a given requirement. Includes charts of overall heat transfer co-efficients.

163 Industrial Felt — Comparative properties of industrial felt for gaskets, packing, vibration isolation, many other uses, are presented in handy reference tables in this 10-pp bulletin

RODA COKE — High carbon — low sulphur — low phos. Unmatched for reduction purposes.



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GENCO ANTHRACITE & BITUMINOUS COALS

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WESTMORELAND COAL COMPANY

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STONEGA COKE AND COAL COMPANY

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JEDDO-HIGHLAND COAL COMPANY

Coals differ in their characteristics — that's why General strives to make sure you get the proper coal for your particular application. We endeavor to insure that every car of coal we ship meets the specific need for which it is intended.

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Branches: Buffalo, N. Y.; Charlotte, N. C.; Cincinnati, Cleveland, Ohio; New York, N. Y.; Norfolk, Va.

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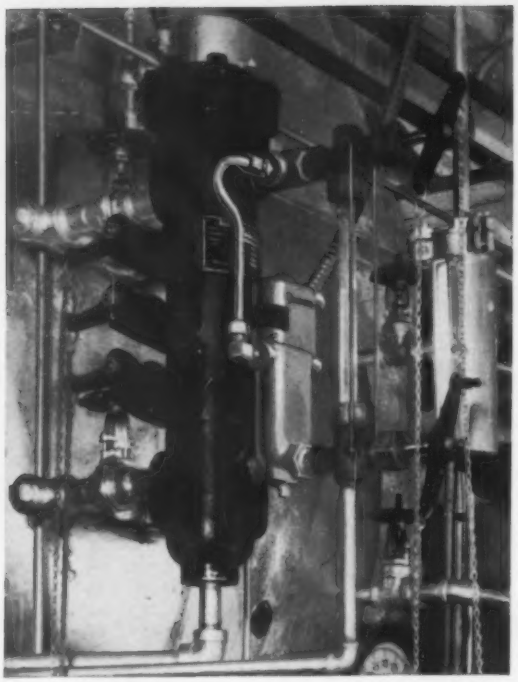


Low Cost Protection

that helps you to avoid water level accidents

What Reliance Levalarms can do for you:

1. operate alarms — low or high water level.
2. actuate fuel cut-out — single or dual.
3. control pumps — start and stop.

Both low and high liquid levels in boilers and various tanks and vessels need "watch-dog" service, as you know. Reliance Levalarms help maintain control by *signalling* dangerous conditions or by actually *motivating* fuel cut-outs, pumps, etc.

Illustration above shows Levalarm EA-15R on a water column. It can serve as fuel cut-out, or cut-out and alarm. Under the cap on top of the column are terminals of electrodes that extend into the column. They form a Levalarm capable of handling a combination of duties such as listed above.

Other members of the valuable "Levalarm Family" are shown at right. Ask for more complete information on these versatile devices that insure positive, economical warnings and control.

EA-7,
float-actuated switch;
low and high alarm.

EA-100P,
float and electrodes;
single or dual fuel cut-out.

EA-101,
electrode; alarms, fuel
cut-out or pump control.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance®

BOILER SAFETY DEVICES

For more data circle 523 on Post Card

by Continental Felt Co. Lists comparative price coefficients, physical and mechanical properties, chemical properties, fabricating methods.

164 For Compressed Air Systems— Aftercoolers for compressed air and gas applications are featured in Bulletin 120 of Davis Engineering Div., Tube Reducing Corp. Sizes, capacities tabulated.

165 For Boring, Drilling — Design and operation details on earth augers, boring heads and drill heads for boring in any kind of soil, hardpan, decomposed rock, caliche, sandstones and ordinary earth are presented in 14-pp Catalog A-2 by Petersen Engineering Co., Inc.

166 Decimal Equivalents — At-a-glance reference data on decimal equivalents for steel tubing—conversion of Birmingham wire gages and fractions to decimals—is available with this handy wall chart from Ohio Seamless Tube Div., Copperweld Steel Co.

When using the Reader Service Cards, please be sure to give your company name and job title, even if you want catalogs sent to your home. Manufacturers prefer to send literature those who identify themselves

167 Improved Gasket Materials — Factors to consider in choosing gasket materials are outlined in 24-pp Bulletin AD-190 of Garlock Inc. Includes selection tables, resistance ratings, design information. Describes characteristics of rubber sheet, compressed asbestos sheet, woven asbestos, vegetable fiber, other materials.

168 Sound and Vibration Control— Catalog 890 by General Rubber Corp. describes a wire-reinforced rubber sound and vibration eliminator designed for use on pipe lines in air conditioning, heating and refrigeraton systems.

169 Compact Cooling Towers—Dimensonal data and diagrams on single-cell and multi-cell cooling towers are presented in this 6-pp bulletin by The Marley Co. along with specifications, performance data, pump head details.

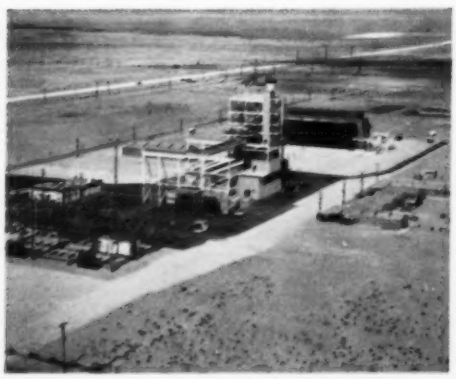
170 Equipment Noise Control — Effective approaches to solving acoustical problems are outlined by Owens-Corning Fiberglas Corp. in 14-pp Publication 1-EA-910-A. Absorption of air-borne and reduction of structurally borne-sound are explained, test methods, performance tables, nomographs and illustrations included.

171 Pipeline Coating — High-density polyethylene pipeline coating which is bonded to steel pipe by a hot-applied "live" adhesive is featured in Bulletin 201 issued by Hill Hubbell Co. Physical and electrical properties, corrosion resistance table and list of typical applications included.

STONE & WEBSTER ADDS
the economy button

Significant economy in the design and construction of power plants — whether steam, hydro or nuclear — is achieved through an accumulation of economies effected all along the line, from site selection to completed project.

Stone & Webster has gained and maintained leadership in power engineering precisely from our ability to produce such economy in completed plants that have established records in both performance and safety. This ability is available to you. Let us discuss your future power requirements.



STONE & WEBSTER ENGINEERING CORPORATION

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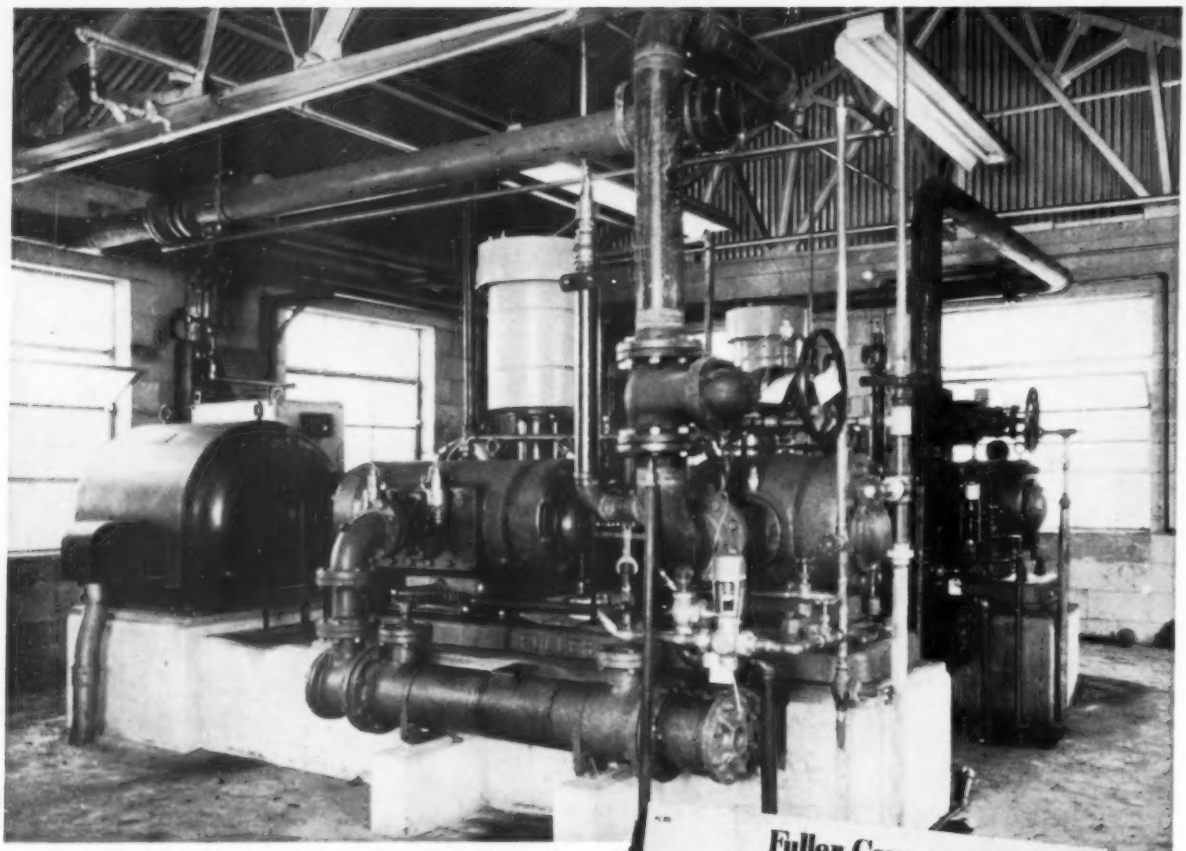

Two C135/135H Fuller Rotary Compressors at the Herbrand Division of the Bingham-Herbrand Corp., Fremont, Ohio, leading manufacturer of forged mechanics' hand tools and steel forgings for the automotive industry. Each compressor is rated 680 cfm, atmosphere to 100/110 psig., at 690 RPM.

Here's the 4-Year Maintenance Bill on Fuller Rotary Compressor at Herbrand Division of Bingham-Herbrand Corp.

So satisfactory was the performance of its first Fuller Rotary Compressor, installed in 1956, that Herbrand Division installed another like it 3½ years later.

When the older unit was inspected after four years operation, no replacement of parts was necessary. After installation of a new gasket (cost $9.35)—to replace the one that had to be removed to make inspection—the compressor continues to add to its service record.

The newer compressor has also been entirely trouble-free, and Herbrand plans a third, when increased air capacity is required. It, too, will be a Fuller—for, as Herbrand says, "These compressors can be classified as maintenance-free."

Because Fuller Rotary Compressors are practically vibration-free, they can be installed without complicated or expensive foundations or structural modifications. They are simple and efficient, with no valves to leak, no seats to grind. Blades automatically compensate for wear. They have forced-feed lubrication to all parts within the cylinder. Rotor, bearings and blades are the only moving parts.

Fuller Compressors range from 30 to 3300 cfm, pressures to 125-lb. gauge.

Write for Bulletin C-5A. It tells the whole story.

See Chemical Engineering Catalog for further details and specifications.

FULLER COMPANY GENERAL AMERICAN TRADE MARK

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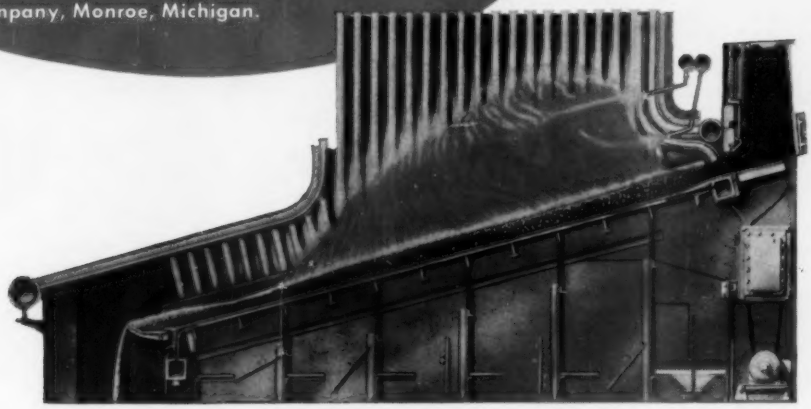
now it's DETROIT VIBRA-GRATE STOKER *and* DETROIT-TAYLOR STOKER

Vibra-Grate and Taylor Multiple Retort Stokers formerly manufactured by American Engineering Company of Philadelphia are now and will *continue* to be manufactured, sold and serviced by Detroit Stoker Company, Monroe, Michigan.



DETROIT VIBRA-GRATE STOKER

All stoker activities of American Engineering Company, a division of United Industrial Corporation, have been transferred to Detroit Stoker Company, Monroe, Michigan where communications relating to all types of stokers formerly manufactured by American Engineering Company should be directed.

Vibra-Grate and Taylor Stoker users, *present* and *future*, will benefit through:

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- **District sales offices or representatives in more cities**
- **Over 60 years of stoker experience**
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STOKERS FOR BOILERS FROM 3,000 TO 500,000 POUNDS OF STEAM PER HOUR CAPACITY.

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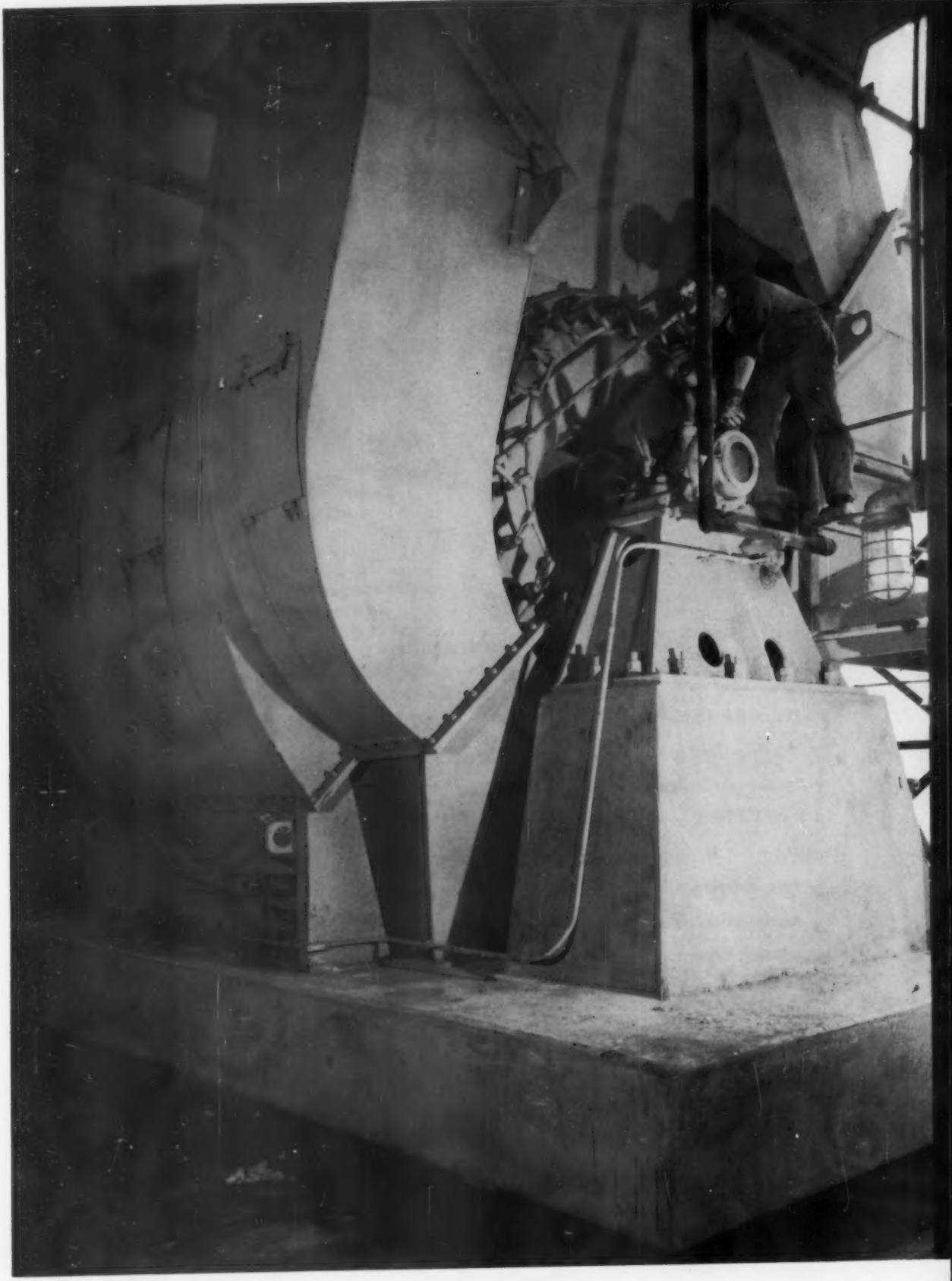


RD Fan used for induced draft on basic oxygen furnace of large steel producer. There are four identical units, each producing 325,000 cfm against a static pressure of 15" wg at 550° F.

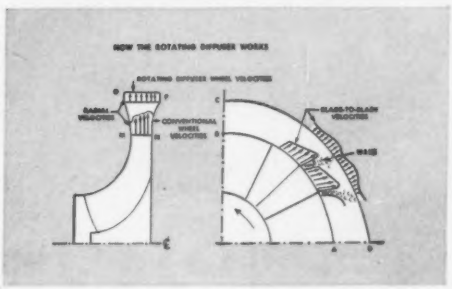
JOY RD FANS CAN PROVIDE PRESSURES UP TO 4.5 PSI AND CAPACITIES UP TO 600,000 CFM

Joy RD Centrifugal Fans, based on a new concept in fan design, can provide any volume of air or gas at pressures up to 4.5 psi in a single stage. This means important savings in initial cost. An equally important saving is their high efficiency over a wide range of volume, which is especially important where load fluctuates. Surging, even on parallel operation, is no problem because the RD Fan is inherently resistant to pressure surge over its entire duty range.

These advantages of the RD Fan are the results of its unique rotating diffuser. Instead of stationary diffusers, the RD diffuser is an integral part of the wheel—added at the blade tips. The rotating diffuser reduces the gas velocity before leaving the wheel and up to 98% of the conversion of velocity to pressure is accomplished with the wheel of the RD Fan.

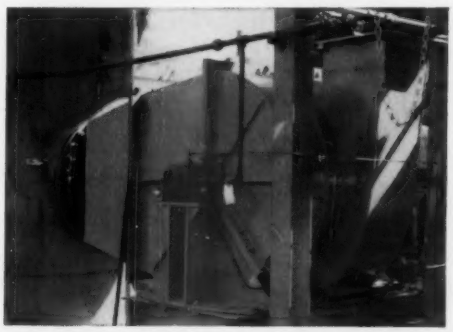
Radial blades in the RD Fan tend to be self cleaning, even when handling dust laden and dirty gases. The rotating diffuser results in low noise levels because of the lower and more regular velocities leaving the wheel and because the blade tips are remote from the cut-off.

The Joy RD Fan is finding steady acceptance in induced draft and forced draft applications in the steel and power industries, in handling chemical process gases, and in heavy duty industrial applications. For extremely dirty or corrosive applications the entire unit may be fabricated of stainless steel. Parts are simple because there are no large castings or close running tolerances. For complete information and duty areas of the RD Fan, write for bulletin 3449-56-C.



HOW THE ROTATING DIFFUSER WORKS

Studies have shown that radial velocities leaving conventional wheels are unequally distributed, as shown in MN. Also there is fluctuation in the blade-to-blade velocities based on $\frac{nN}{60}$ where n is the number of blades and N is the speed in rpm. The Rotating Diffuser reduces the gas velocity before leaving the wheel, which allows more uniform flow as shown at OP and CD. Without the rotating diffuser, velocities are much higher and erratic as shown at AB and MN, causing turbulence, friction losses.



Joy RD Fan at eastern CO_2 plant. Unit has capacity of 27,800 cfm, at 3 psi. Drive is a 450 hp steam turbine.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

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YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

WHY OVER 16,000 ENGINEERS CHOOSE AND USE YARWAY SEATLESS BLOW-OFF VALVES

Yarway Seatless Blow-Off Valve in open position. Note full, free discharge.

Valve in closed position. Note tight shut-off.

SAVING IN MAINTENANCE COSTS
FREEDOM FROM BOILER OUTAGES

These are the reasons—proved again and again in thousands of installations over the last 50 years, as *Yarway Seatless* has become virtually "standard" on low to medium pressure boilers.

Check these features that earn such acceptance for this time-honored but truly modern, compact valve:

- **UNIQUE SEATLESS DESIGN**—full free discharge... combined with drop-tight shutoff... and no seat to score, wear, clog or leak.
- **BALANCED HOLLOW SLIDING PLUNGER**—made of nitralloy with a "glass hard" surface that resists erosion, high temperatures and sudden shocks. "Polishing" action lengthens life of packing rings.
- **COMPRESSON YOKE SPRINGS** — heavy coil springs under yoke nuts maintain continuous pressure on reinforced packing above and below valve port to keep valve tight.
- **BALL BEARING HANDWHEEL**—for smooth operation, easy opening and closing.
- **NON-RISING STEM.** Valve cannot be opened or closed too quickly. Water hammer is prevented.
- **STREAMLINED BODY AND YOKE.** Strength where strength is needed—without unnecessary bulk.
- **CHOICE OF FIVE SIZES—1″ to 2½″,** angle or straightway designs, flanged or screwed ends, available in any tandem combination.

If you are planning purchase of a new boiler, or modernization of present boilers in pressure ranges up to 415 psi, *insist* on protecting your investment with new Yarway Seatless Blow-Off Valves.

They'll give you maximum dependability, minimum maintenance, and satisfaction that is beyond price—all at a very *low* cost per year.

Write for Yarway Bulletin B-427.

For more data circle 528 on Post Card

PULVERIZED LIGNITE FUELS LARGE UTILITY BOILER

H. R. Cowles describes a unique Minnesota plant

H. R. Cowles has been associated with Otter Tail Power Company since 1947. In 1958 he was made Chief Engineer. Before joining Otter Tail, Mr. Cowles held engineering and operations positions with Lee Wilson Engineering Co., Cleveland, Ohio, and General Motors. Mr. Cowles graduated from Case Institute of Technology in 1930 and 1932 with B.S. and M.S. degrees in electrical and mechanical engineering, respectively, and is a registered mechanical and electrical engineer in Ohio, Minnesota and North Dakota. From 1942 to 1946 Mr. Cowles was in the U.S. Navy and directed the Material Laboratory at the Mare Island Naval Shipyard from 1943 to the end of World War II.

FIRST AND LARGEST pulverized lignite reheat boiler in the northern Great Plains area completed a year of successful operation while contributing substantially to the art of burning North Dakota lignite.

Hoot Lake Plant of the Otter Tail Power Company located in northwestern Minnesota at the junction of the Otter Tail River and a diversion system that provides a 70-foot head of water for hydro and condenser cooling purposes. A 47-year analysis of river flows shows a maximum monthly average of 362 second-feet for the month of June and a minimum average of 142 second-feet during the month of January. This water supply can be augmented by wells during drought periods.

Initial units were 1060 and 1100-kw hydroelectric generators constructed in 1913 and 1916, respectively. They still operate with the original hydro wheels, but each of the generators has been either replaced or rewound.

Two 1500-kw steam units were added in 1920 and 1922. These units were retired in 1950 and 1951, but the concrete building was renovated in 1958 so that the former turbine room is now used for a plant machine shop and the former boiler room houses two demineralizer boiler water treating plants.

In 1946 a 7500-kw steam-driven turbine-generator unit was added. This plant is now using the new 300-ton-per-hour lignite coal handling system, and it is expected that the unit will operate as a peaking unit for the rest of its economic life.

Newest unit, which burns pulverized lignite, was placed in operation during August 1959. The boiler is a tangentially-fired unit continuously rated at 400,000 pounds per hour. Reheat temperature is controlled by tilting the burners as well as with a spray type desuperheater. Primary steam temperature is controlled by means of a spray type desuperheater located between the high and low temperature stages of the superheater.

Boiler design and performance were predicted on North Dakota lignite having a Btu value per pound (as fired) of 6900, and a moisture content of 37 per cent. Four bowl type pulverizers rated at 32,700 pounds per hour each were selected only after fully considering all the economic factors accompanying mill selection as well as the variable characteristics of present and future sources of North Dakota lignite. Automatic sequential electric-operated steam soot blowers and automatic sequential ash removal are installed, and both systems are controlled from the centralized air-conditioned control room.

TURBINE RATING. Turbine is a single-flow, single-casing unit with one row of 23-inch last stage buckets, and is designed for 400,000 pounds per hour throttle flow with initial steam conditions of 1450 psig, 1000 F and reheat to 1000 F. The turbine unit started out at a nominal nameplate rating of 50,000 kw with an expected steam flow of 375,000 pounds per hour. It was determined later by an economic study that 3500 kw of additional capacity could be obtained at a low incremental cost by designing for a 400,000-pound-per-hour throttle flow. This results in the nonstandard nameplate rating of 53,500 kw. During test operation an output of 63,500 kw was attained with the top heater bypassed.

Design used requires a turbine foundation 54 feet long and 27 feet wide as compared to a comparable tandem-compound double-flow reheat machine requiring a turbine foundation 60 feet long and 24 feet wide. The economic factors associated with

MAJOR EQUIPMENT USED AT OTTER TAIL'S HOOT LAKE PLANT

Boiler Equipment

Boiler: One 400,000 lb per hr semi-outdoor reheat unit, C.E.

Air Heater: One 157,100 sq ft Ljungstrom regenerative, Air Preheater Corp.

Soot Blowers: Steam blowing, electric operated, Diamond Power Specialty.

Dust Collector: Mechanical type, Western Precipitation Corp.

F.D. Fan: One 167,000 cfm, DIDW housing with outlet damper and hydraulic coupling, American Blower Corp.

I.D. Fan: One 262,000 cfm, DI 2/3 DW housing with outlet damper and hydraulic coupling, American Blower Corp.

Pulverizers: Four Raymond Mills each rated at 16 tons per hr, Combustion Engineering.

Coal and Ash Handling

Lignite Handling System for 300 tons per hr, of R.O.M. lignite. Designed for future capacity of 450 tons per hr, Link-Belt Co.

Coal Scales: One Electronic belt-type weightometer designed for 450 tons per hr, Merrick Scale Mfg. Co.

Ash Handling: One 20 ton per hr pneumatic ash and fly ash system with 200 ton live storage glazed tile silo, United Conveyor Corp.

Feedwater Equipment

Closed Feedwater Heaters: Four: No. 1—1240 sq ft; No. 2—1400 sq ft; No. 4—1790 sq ft; No. 5—1830 sq ft, Westinghouse Electric Corp.

Deaerating Feedwater Heater: One 417,150 lb per hr counterflow tray type with 4000 gallon vertical storage tank, American Water Softener Co.

Boiler Feed Pumps: Two full capacity, barrel type, each rated at 1010 gpm, with speed control by American Blower hydraulic couplings; Worthington Pump & Machinery Co.

Demineralizer: One 48 gpm maximum rated two bed demineralizer with mixed bed polishing unit, Cochrane Corp.

Turbine-Generator Equipment

Turbine: One 53,500 kw 3600 rpm, 1450 psig, 1000/1000 single casing, single flow reheat, General Electric Co.

Generator: One 64,000 kva, 3 phase, 60 cycle, 13,800 volt, 3600 rpm, rated 0.64 SCR at 30 psig hydrogen pressure with 4 gas coolers suitable for 95 F cooling water, General Electric Co.

Exciter: One geared, room cooled, 200 kw, 250 v at 1778 rpm, G.E.

Condenser: One 30,000 sq ft, two pass with divided water boxes designed for 45 psig, Allis-Chalmers.

Condensate Pumps: Two, 700 gpm each, vertical with TDH of 398 ft, Peerless Pump Co.

Circulating Water Pumps: Two—Horizontal split case rated 20,000 gpm each with TDH-150 ft, Ingersoll-Rand Co.

Cooling Tower: One 4-cell induced draft, rated 30,000 gpm, J. F. Pritchard & Co.

Instruments and Controls

Combustion Control, Hagan Chemicals & Controls, Inc.

Steam Temperature Control, Bailey Meter Company.

Level Controls, Black, Sivalls & Bryson, Inc.

Mechanical Control Board & Instruments, Hagan Chemicals.

Recorders, Leeds & Northrup.

Pressure Reducing & Desuperheating, Republic Flow Meter Co.

Turbine Supervisory Instruments, General Electric Co.

Control Air Compressors, Joy Mfg. Co.

Electrical Equipment

Main Power Transformer: One 60,000 kva, General Electric Co.

Auxiliary Power and Lighting Transformers: 3750/4687, 5000/6250, 300, 1000, 150 kva, Westinghouse Electric Corp.

115 kv Breaker: 800 amp, Westinghouse Electric Corp.

Tie Breaker (Auxiliary), General Electric Co.

Motors, 2400 and 480 volt, Westinghouse Electric Corp.

Electric Control Board, Westinghouse Electric Corp.

Isolated Phase Bus Duct: 3000 amp—14.4 kv, 2000 amp—4.16 kv, Westinghouse Electric Corp.

Other Equipment & Services

Major Valves, Crane Company.

Passenger Elevator, 2000 lb, Otis Elevator Co.

Turbine Room Crane (30 ton), Manning, Maxwell & Moore.

Stack, 225 ft high, Consolidated Chimney Co.

Piping, Pittsburgh Piping & Equipment Co.

Yard & Circulating Water, Fegles Construction Co.

Electrical Contractor, Commonwealth Electric Co.

Engineers & Construction Supervision, Burns & Roe, Inc.

Substructure, T. F. Power Co.

General & Mechanical Contractor, Fegles Construction Co.

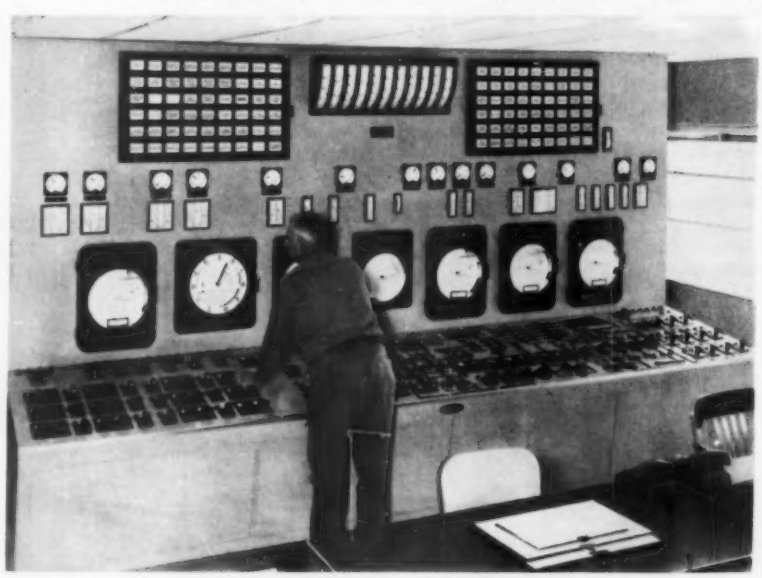
the compact machine arrangements, together with the manufacturers' price differential that existed in 1955 when the unit was purchased, more than offset the poorer efficiency at 1½-inch Hg absolute designed backpressure. Tests conducted during the first two months' operation of this unit indicated that the temperature leaving the high-pressure section of the turbine was approximately 25 degrees lower than design. Additional tests demonstrated that the high-pressure section was about 5 per cent higher than expected. To take full advantage of this favorable characteristic, additional reheater surface was added to the boiler during the first extended plant outage.

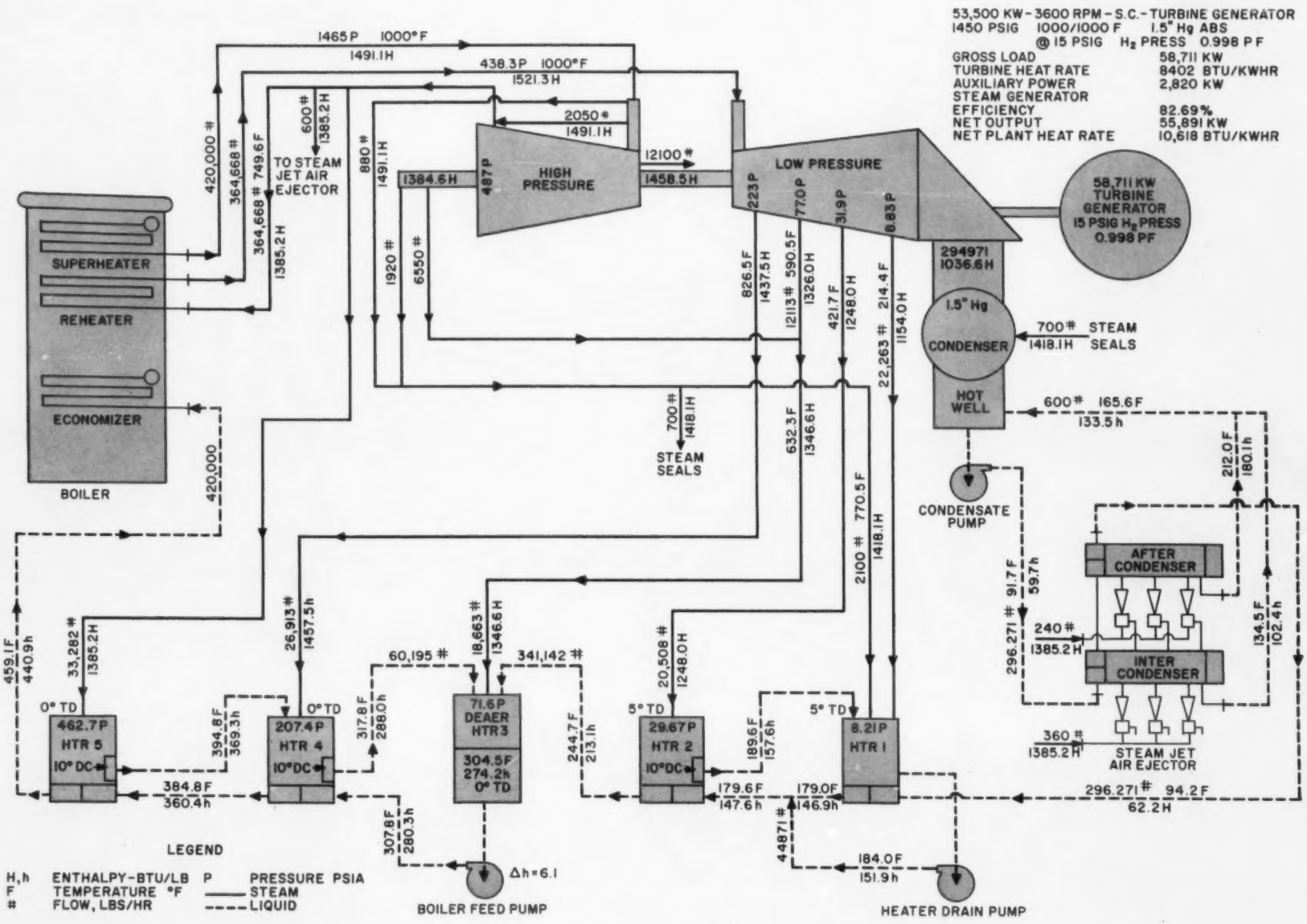
Characteristics of North Dakota lignite have created operating problems which might be termed "growing pains." However, through the efforts of all parties associated with the project, the art of burning a low-grade solid fuel is being advanced so that larger generating units can be scheduled for the future power requirements of the area.

Design of a third lignite burning boiler-turbine unit, nominally rated 60/66,000 kw, is now in progress; this is scheduled for completion in 1964, and will give the station an ultimate net capability of 138,000 kw. Total cost of the completed North Dakota lignite-fired steam plant is expected to be $24,394,000.

Dimensions of the new building are: 106 ft wide and 170 ft long, with roof heights of 65 ft over turbine room and 119 ft over boiler-bunker room. Enclosure for the building is Alcoa aluminum siding (inside and out), with 1 inch of rigid fiberglass insulation.

Control panel at Hoot Lake. Hagan Ring Balance meters and compact operating console make single-operator control easy




53,500 KW - 3600 RPM - S.C. - TURBINE GENERATOR
1450 PSIG 1000/1000 F 1.5" Hg ABS
@ 15 PSIG H2 PRESS 0.998 P F
GROSS LOAD 58,711 KW
TURBINE HEAT RATE 8402 BTU/KWHR
AUXILIARY POWER 2,820 KW
STEAM GENERATOR EFFICIENCY 82.69%
NET OUTPUT 55,891 KW
NET PLANT HEAT RATE 10,618 BTU/KWHR
1465 P 1000° F
1491.1 H
438.3 P 1000° F
1521.3 H
2050 #
1491.1 H
12100 #
1458.5 H
1384.6 H
487 P
HIGH PRESSURE
LOW PRESSURE
223 P
77.0 P
31.9 P
6.83 P
58,711 KW TURBINE GENERATOR 15 PSIG H2 PRESS 0.998 PF
420,000 #
364,668 #
749.6 F
364,668 #
1385.2 H
600 #
1385.2 H
TO STEAM JET AIR EJECTOR
880 #
1491.1 H
1920 #
6550 #
826.5 F
1437.5 H
12113 #
590.5 F
1326.0 H
421.7 F
1248.0 H
22,263 #
214.4 F
1154.0 H
294971
1036.6 H
1.5" Hg
CONDENSER
700 # STEAM
1418.1 H SEALS
HOT WELL
600 # 165.6 F
133.5 h
SUPERHEATER
REHEATER
ECONOMIZER
BOILER
420,000
700 #
1418.1 H
STEAM SEALS
632.3 F
1346.6 H
CONDENSATE PUMP
212.0 F
180.1 h
AFTER CONDENSER
INTER CONDENSER
240 #
1385.2 H
296.271 #
91.7 F
59.7 h
134.5 F
102.4 h
360 #
1385.2 H
STEAM JET AIR EJECTOR
459.1 F
440.9 h
33,282 #
1385.2 H
0° TD
462.7 P
HTR 5
10° DC
384.8 F
360.4 h
394.8 F
369.3 h
26,913 #
1457.5 h
0° TD
207.4 P
HTR 4
10° DC
317.8 F
288.0 h
60,195 #
18,663 #
1346.6 H
341,142 #
71.6 P
DEAER HTR 3
304.5 F
274.2 h
0° TD
307.8 F
280.3 h
Δh = 6.1
BOILER FEED PUMP
20,508 #
1248.0 H
5° TD
29.67 P
HTR 2
10° DC
244.7 F
213.1 h
2100 #
770.5 F
1418.1 H
5° TD
8.21 P
HTR 1
189.6 F
157.6 h
179.6 F
147.6 h
179.0 F
146.9 h
296.271 #
94.2 F
62.2 H
44871 #
184.0 F
151.9 h
HEATER DRAIN PUMP
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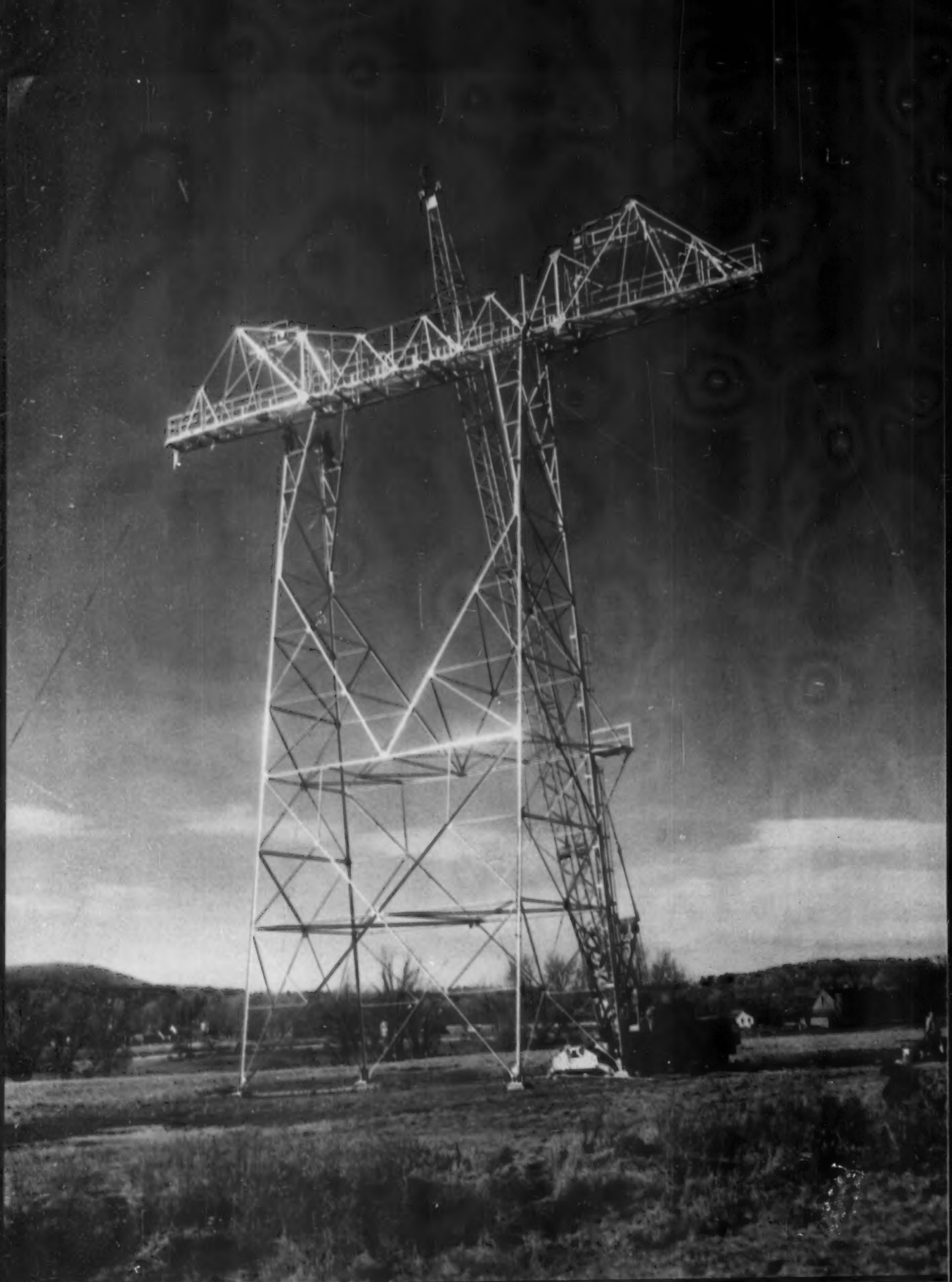
FLOW, LBS/HR
P PRESSURE PSIA
STEAM
LIQUID



PROBLEMS IN DESIGN AND TESTING OF EHV TRANSMISSION LINES

Dr. Pier Abetti, of General Electric, continues the discussion of developments leading to "Project EHV"

INSULATION DESIGN of high-voltage and extra-high-voltage lines has made significant progress in the last 20 years. For instance, the 287-kv Hoover Dam-to-Los Angeles lines were built in 1936 with twenty-four 5-inch insulators, equivalent to about twenty-one 5¾-inch insulators. The transformer BIL was 1500 kv. At present the same insulation appears suitable for 460 to 500-kv systems. In fact, the Project EHV line is insulated with twenty-two 5¾-inch insulators for 460 to 500-kv operation. (The basic impulse insulation level of the General Electric power transformer for the 460-kv line of Pennsylvania Electric, known as *Penelec*, is 1425 kv.)

According to the conventional designation by "steps" of reduced insulation, this transformer is 2½ steps below the full insulation level of 2050 kv. Line insulation is determined by three factors: sixty-cycle voltages and overvoltages, switching surges, and lightning. As system conditions vary, and progress is made in these three areas (and in apparatus design), one or the other factor becomes predominant. For instance, when the 345-kv lines of AEP-OVEC and Commonwealth Edison were built, it was believed that lightning would be no problem, and an outage rate was calculated by the AIEE method of 0.25 flashovers per 100 miles per year. *The performance measured in the field has been at least 20 times worse.* English 275-kv lines, and French 400-kv lines, have also shown rather poor lightning performance. On other EHV lines lightning is no problem, and thus *switching surges* are becoming the factor which determines line insulation.

Fig. 1 (left). Aluminum transmission tower for Project EHV is 105 feet high and weighs 11,400 pounds

Sixty-cycle operating voltages are normally not the determining factor, except in areas subjected to severe insulation pollution, like the California coast. Sixty-cycle overvoltages, lasting for one or more seconds, may be a problem on long EHV lines during load rejection or overspeeding of generators. For most American conditions, however, the main factors to be considered are lightning and switching surges.

To study the effect of lightning on line design and performance, the problem may be subdivided into four successive steps: (1) The natural characteristics (wave shape and amplitude) of lightning are determined as it strikes the line; (2) line response is determined; that is, the voltage across the line insulation (wave shape and amplitude) as a function of the known characteristics of the lightning stroke; (3) dielectric strength of the insulation is determined, as a function of the voltage (wave shape and amplitude) applied to it; and (4) since the characteristics of the lightning stroke (length of front and tail, amplitude, frequency, location, etc.) are highly variable, this process is repeated to take into account the statistical distribution of these variables, and the probability of line flashover is finally determined.

SOLVING THE PROBLEMS. Work done in solving these problems will be described in brief. The most difficult problem is, undoubtedly, to determine accurately the characteristic of natural lightning, because of the great variability of this elusive natural phenomenon. Many oscillographic records have been obtained (in the past 30 years) of lightning strokes to tall buildings, tall masts and balloons; many amplitudes of strokes to transmission line towers have been recorded by magnetic links. Unfortunately, this information is not as valuable for transmission line design as was expected. First, because the characteristics of lightning striking very tall objects, such as the Empire State Building, are different from those of lightning striking a 100 to 150-foot tower. Next, most magnetic link measurements were evaluated incorrectly, because the distribution of the magnetic field around the tower legs is not uniform. In any case, magnetic links yield only the *amplitude* and *not the wave shape.*

THREE NEW INSTRUMENTS have been developed in Pittsfield for measuring wave shape and amplitude of lightning. These are the teinograph, the line-surge oscillograph, and the shielding-failure indicator.

The *teinograph* (from the Greek *teinein*—to stretch, and *graphos*—to write) records the wave shape of lightning by a delay line and a series of 17 Lichtenberg figures. It has no moving parts, requires no power supply, no photographic film in one version, weighs 20 lb and is easy to install. It is automatically taken out of service after a stroke has been recorded. Servicing may be done once after every storm period, or at the end of the lightning season. In the latter case, all records after the

first one will be lost if an instrument is struck by lightning more than once. Forty teinographs are now installed, or are being installed, on 345-, 220-, and 115-kv lines.

The line-surge oscillograph is a small, rugged, but accurate cathode-ray oscillograph, costing approximately one-quarter the cost of ordinary oscillographs. It is turned on automatically whenever there is a storm in the vicinity of the instrument, by proving the earth's electric field. This type requires a power supply (110 volts alternating current, or batteries), and it must be serviced after six hours of operation. Approximately 70 of these instruments are installed on the Penelec 460-kv line, Project EHV 650-kv line, and on a 220-kv line.

The *shielding-failure indicator* is a simple, inexpensive device which determines, by means of a Lichtenberg figure, whether lightning hit the ground wires or the phase conductors. Five hundred of these instruments are now installed on 100 miles of the AEP 345-kv lines.

Response to the system to the lightning stroke is determined by tests on a geometrical model of the line. The models usually have a length scale of 1 to 25 or 1 to 50, and represent three towers and two spans. According to model theory, the time scale must be equal to the length scale. Consequently, one microsecond of natural lightning becomes (for the 1 to 50 model) 1/50th of a microsecond, or 20 millimicroseconds. Special techniques had to be developed to measure these extremely short intervals of time, since one millimicrosecond corresponds to the time required by light to travel one foot. Models are easily varied to take into account different conditions; for instance, various ground resistances.

DIELECTRIC STRENGTH of insulation is known from tests made in the Pittsfield High Voltage Laboratory. For Project EHV, extensive tests were made on gaps, pedestal insulators and insulator strings, with 18 to 48 suspension insulators.

It is felt that lightning performance of EHV lines can now be predicted with confidence and that lightning normally will not be the determining factor in establishing the insulation of EHV lines. Therefore, *internal* overvoltages, rather than *external* overvoltages, are becoming more and more the determining factor for line and station design. Such is the case for Project EHV insulation. Transient analyzer studies are used to determine the magnitude and wave shape of switching surges. Tests made in the Pittsfield High Voltage Laboratory, with surges ranging from 100 × 1000 Ms to 1000 × 3000 Ms, have shown that wet switching-surge strength of long gaps and long insulator strings is of the same order of magnitude as the wet 60-cycle strength. These results are at variance with data obtained at lower voltage, and indicate that, unless switching surges are drastically controlled, it may not be possible to build transmission lines to operate above 1000-kv alternating current.

Extra-high-voltage lines, in the 500 to 700-kv range, will be needed in the future to transmit very large blocks of power economically over limited rights-of-way. This may be predicted with confidence in view of the discussions in two previous articles on the subject of EHV.

Since these lines will carry a substantial portion of the generation of a power system or of a power pool, and will be used as interconnections to reduce installed system capacity, they must perform their function with a very high degree of reliability. Consequently, proved solutions must be obtained to the many problems of EHV power transmission. Many of the electrical problems of line design have been reviewed in previous articles, but the mechanical problems, such as ice and sleet effects, aeolian vibrations, and the behavior of spacers for bundle conductors, are equally important. Of paramount importance also are the problems of EHV apparatus design: transformers, circuit breakers and disconnect switches, lightning arresters, series capacitors, reactors, etc.

OPTIMUM SOLUTION. In order to solve these problems, various means are available: analytical studies, laboratory investigations, short experimental lines carrying only charging current and with limited terminal apparatus, and prototype EHV systems. All of these means are necessary to obtain the optimum solution, and the General Electric Extra-High-Voltage Project (called "Project EHV" for short) was launched on this basis.

"PROJECT EHV"

Following is a detailed account of this world famous research project which was under the direction of Dr. Pier Abetti

PROJECT EHV comprises a complete prototype transmission system, which is now operating at the 500-kv level and which will operate later at the 650-kv level (750-kv maximum). It was announced in 1958, but technical work and acquisition of the right-of-way have been proceeding since the beginning of 1957. Cost of the entire project is estimated at $7,500,000, and is being contributed by eleven cooperating manufacturers and one utility, as listed in the accompanying table on page 45.

Construction work on the site was started in May 1959, and operation at 460-500 kv of the North Station and adjacent section of the line was started in December 1960. In 1962 the voltage will be raised to 650-750 kv, and it is planned to continue testing until the summer of 1963. On December 8, 1960, the line was raised to 720 kv, thereby attaining the highest transmission line voltage in the world.

CORONA PROBLEM. The single expanded conductor, 2.32 inches in diameter, was designed for operation at 460-500 kv, and therefore it is in heavy corona. In fact the corona loss exceeded the upper limits of the recording apparatus and was approximately several hundred kw per 3 phase per mile. In contrast, the bundle of our conductors used on the project was designed for operation at 650 kv, and is completely free of corona, even with 10 per cent overvoltage.

Project is located in the towns of Lenox and Lee, Berkshire County.

LIST OF COMPANIES PARTICIPATING IN PROJECT EHV

NAME	CONTRIBUTION
Alcoa (Aluminum Company of America	Line conductors, spacers and hardware; station structures and buses; one aluminum tower, lightning rods.
Aluminum, Ltd.	Guyed aluminum tower.
American Bridge Division of U.S. Steel	Design of steel towers.
Anchor Metals, Inc.	One steel tower.
Brewer-Titchener Corporation	Forgings for corona shields and other hardware.
Commonwealth Associates, Inc.	Design of two steel towers.
General Electric Company	Project management. Apparatus and instrumentation. System design, construction and operation. Data evaluation.
Petersen Engineering Company	Tension-stringing equipment.
Prestressed Concrete Institute	Prestressed concrete tower.
Rilco Laminated Products and Weyerhaeuser Companies	Laminated wood tower.
Stone & Webster Engineering Corporation	Right-of-way acquisition, line design and erection.
Western Massachusetts Electric Company	Electric power, system design and operation.

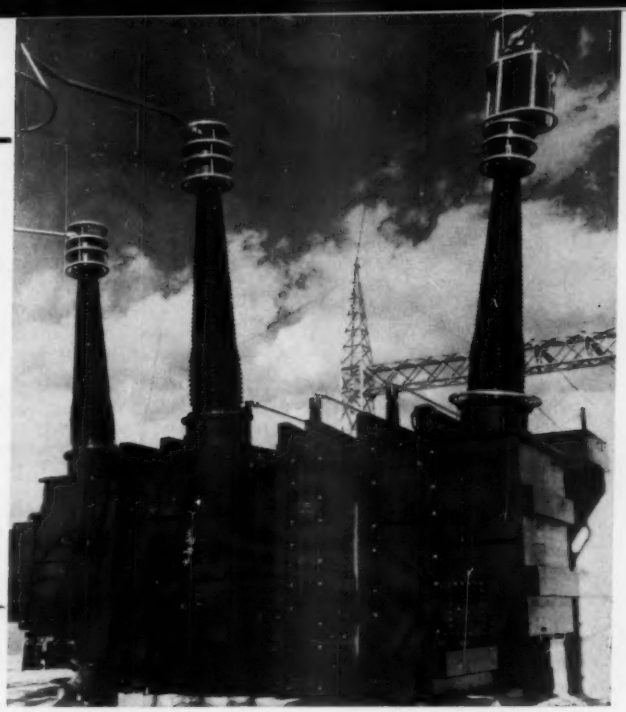


Fig. 2. View of the 40,000-kva 115/650-kv autotransformer which was installed in North Station

western Massachusetts. This location was chosen because it is only a few miles from the Pittsfield Plant of General Electric, and from the High Voltage Laboratory. This is a major center of extra-high-voltage research, under the successive direction of Peek, McEachron, and Hagenguth. Weather conditions in this zone are representative of the northern portion of the U.S.A. Heavy rainfalls, snowstorms, sleet storms, and strong winds impose severe design conditions on local transmission lines. The isokeraunic level (thunder-lightning index) is 27, about average for the U.S.A.

EHV line runs along the Housatonic River for a length of 4.3 miles, at elevations between 950 and 1080 feet above sea level. Soil conditions are quite varied, including sand, pasture, rocky woods and swamp. Ground resistivity varies between 10 and 1000 ohms-meter, and counterpoise is being used in certain portions of the line.

Length of the line is considerably greater than other experimental lines, which range from 0.03 to 1.4 miles. This longer length, which entails a corresponding increase in cost, was selected after a thorough study of the differences in the performance of short and long lines, particularly with respect to radio influence (RI) and corona loss.

Width of the right-of-way is 300 feet. This would be sufficient for a double-circuit 650-kv a-c line, a single-circuit 1000-kv a-c, or 2 × 600-kv d-c line, the highest transmission voltages conceivable with the present status of technology. Additional land was acquired for the two terminal stations and five test areas, approximately at equal distances along the line, where 23 RI meters and many other instruments are located.

LESS CONSERVATISM. In the past, extra-high-voltage research installations have been designed as open-ended, experimental lines with limited and non-representative terminal equipment. Usually, no effort was made to design the line for a given voltage, but rather a broad range of conductor sizes, insulation distances, etc., was covered, selecting from these (by interpolation) the parameters for the design of the final system. This approach achieves one workable solution for the final system, but not necessarily the optimum solution.

Philosophy for the design of Project EHV is more advanced, similar to that used by the utilities in establishing a new system. On the basis of the forecasts described above, it was decided to design all Project EHV line configurations and apparatus specifically for 460-500 and 650 kv. The main difference between the Project EHV design and a system designed by a utility is that less conservatism was used in determining safety factors. Also, after some time, the insulation will be decreased, or the voltage raised, to find out whether the actual safety factors correspond to the calculated values.

Lowest voltage attainable on the Project EHV system is 380 kv, and the highest voltage is 750 kv. These values are well below, and above, the rated voltages of 500 kv and 650 kv, respectively. The selection of 380 kv as the lowest voltage permits correlation with the results obtained on European 380-kv systems and on many experimental lines, such as Tidd, Leadville, Chevilly, Rheinau and Leatherhead. Any voltage between 380 and 750 kv is obtainable, in 0.8 per cent steps.

PROJECT EHV includes prototypes of extra-high-voltage apparatus to be used on future 500-kv, and higher, voltage systems. Actual service experience is being obtained for several years under normal weather and operating conditions. For instance, the capacity of the autotransformers was set at 40,000 kva because calculations showed that this was the smallest size of forced-oil-cooled units, which would have basically the same construction and geometry of larger units of the same basic impulse insulation level (BIL). The 40,000-kva, 650-kv, 1925-kv BIL autotransformer is shown in Fig. 2.

In the September issue of POWER ENGINEERING, Dr. Abetti continues his detailed account of the design and operation of Project EHV.

Targets for Tomorrow in Electric Power

29TH ANNUAL CONVENTION OF EDISON ELECTRIC INSTITUTE

At EEI meeting, left to right: Sherman R. Knapp, retiring President of EEI; Philip Fleger, new President; new VP W. W. Lynch

ONCE AGAIN the top executives of the investor-owned utility companies gathered in New York for their annual meeting. It was extremely well attended and had as its general theme "Targets for Tomorrow in Electric Power."

Welcoming the group officially for the City of New York, **Mr. Harland C. Forbest**, Chairman of the Board, Consolidated Edison Co., greeted the members and guests, and offered them the proverbial key to the city.

In the opening address **Sherman R. Knapp**, President of the Institute, stressed the need for more education and urged that pooling of power facilities be accelerated at a greater pace than in the past years. He called for greater use of imagination and ingenuity in producing and using electrical energy.

Mr. Knapp noted the great challenge which the investor-owned utilities face, and stressed the fact that national defense, conservation of resources, expansion of power systems, and new ways of producing electric energy are some of the conditions which must be faced in the immediate future.

Commenting on the growth of Federal government power, Mr. Knapp stated, "If plans of the Interior Department are carried out, they would constitute the highway to complete nationalization of our industry."

FOLLOWING Sherman Knapp, **Dr. Emerson P. Schmidt**, Director of Economic Research, U.S. Chamber of Commerce, gave an extensive talk on the general subject of how government is rapidly creeping into more businesses in the United States. He sounded a warning to all members and gave one bit of solid advice for the proponents of more government hydroelectric plants. Dr. Schmidt said that such people should be reminded that "One pound of coal has about the same energy as one ton of water falling one mile."

Mr. Andrew Heiskell, Chairman of the Board, Time Inc., gave some sage advice by recommending that investor-owned utilities must fight government projects in areas other than where the proposed project is to be. He said that in his opinion utilities are not doing the proper kind of public-relations job. Mr. Heiskell referred to the publicity job by stating that utilities were "trying to move a mountain with a toy shovel." He believes very strongly that they must work at local levels and that they cannot just promote load growth, but must fight government ownership by educating their customers on the tax problems involved. He advocated that utilities stop fighting a defensive battle, and go on the offensive.

ONE ITEM of great importance stressed by Mr. Heiskell was the fact that the public does not now know about all of the existing power pools in the country, which give the customers 25 per cent reserve capacity. He believes that more attention should be given to public relations, both at local level and on the Washington scene. He cited the excellent job being done by AT&T, and stated that the present public-relations budget, in the investor-owned utilities, is far too low to be effective.

On the subject of EEI's new research program, **Mr. Willis Gale**, Chairman of Commonwealth Edison Company, reported on the new research projects which are being done by selected engineering schools over the country. He highlighted the current projects and gave an indication of what may be tackled in the future. One of the most interesting is, of course, that of "heat storage."

Speaking of the industry's growth to date, and its precarious future, **Dr. Philip Sporn**, President of American Electric Power Co., gave a most interesting and challenging speech. In it he offered a word of challenge to the members of the

EEI by stating that competition for investor-owned utilities is increasing at an alarming rate.

Dr. Sporn called attention to the fact that, to date, 23 per cent of our total generation now is by public power. And, as a new item to be he mentioned the fact that the natural gas industry is promoting the use of fuel cells for residential use, in a big way. He referred to an article in the Oil and Gas Journal, which claims that the gas companies would be able to furnish cheaper electricity with fuel cells than could be obtained from utility companies.

In a very straightforward manner, Dr. Sporn gave some criticism to the Institute members by citing their complacency in a number of sectors. For instance, he said that practically all EEI speakers have nothing but praise for the industry. He believes that this is a very bad policy, and suggested the industry seek constructive criticism. He felt that the convention should have been in Washington, instead of New York, so that some of our legislators could tell the membership some of the criticism being received against the industry.

ON THE SUBJECT of engineering talent, Dr. Sporn spanked the industry for its laxness in enticing bright young engineers. He feels that more, and better, engineering talent is necessary if the industry is to progress at the rapid pace indicated.

On Exotic Power, **Leonard J. Linde**, Director of Engineering Services, Allis-Chalmers, spoke on current research being carried on by large electrical manufacturers. He dwelt particularly on the field of plasma physics and advances in thermonuclear fusion research. (A special article on the C-Stellarator at Princeton University appears on page 56 of this issue. Mr. Linde has been in charge of design of this project.)

Mr. Linde also discussed the exciting possibilities of MHD, and the possibility of attaining competitive-cost power with a plant of 300 Mw(e) capacity.

James Young, of General Electric, reviewed the research in electrical transmission, and barriers which must be broken to provide future transportation of bulk power. Agreeing with some other top authorities, Mr. Young feels that 500 kv should be the standard adopted for future EHV development in the U.S. He believes that this voltage level will be the first step in common use, and that 700 kv would be the ultimate.

Dwelling on the subject of esthetics (and economics) in residential distribution, **Dr. J. A. Hutcheson**, of Westinghouse, gave a most interesting talk and suggested a number of ways in which utilities could win greater acceptance for distribution by glamorizing the equipment used for the job. This prediction included remote meter-reading, and billing, with computers; also, integrated street-lighting poles and distribution transformers.

A COMPARISON between Russian and American developments in the power industry was given quite convincingly by **Edwin Vennard**, Managing Director of EEI. According to Mr. Vennard, we are on an equal footing as far as developments in thermal generation are concerned; however, the U.S. consumption of electricity is double that of Russia. He feels that because of our rapid expansion, we will stay ahead of the Russians.

Maj. Gen. J. D. Nichols said that it would be a relatively short time when nuclear power would be realistic in areas of the U.S. experiencing high fuel costs. He strongly urged that the industry standardize on water-cooled and water-moderated reactors. According to General Nichols, nuclear energy will have a much faster development than has been predicted by some of the more cautious authorities.

On the load-building side, **J. K. Norton**, President of Southern California Edison, and **William Sheppard**, Vice-President of Sales, Arkansas Power and Light, gave convincing proof that the all-electric home is a very definite part of the American future. Great strides have been made, according to both speakers, and a tremendous publicity program is now under way in this particular field.

Ralph M. Besse, President of Cleveland Electric Illuminating Company, gave his views on how management should obtain high-calibered talent and train them to be the managers of the future. According to Mr. Besse, utilities have not utilized all of the best methods for securing top-talent graduates from the engineering schools; he gave a number of ground rules for training these engineers and grooming them for future executive jobs.

Money matters, which have always been a most important part of the utility industry, were discussed by a panel of experts which included **Charles Delafield**, Vice-President, Consolidated Edison Company of New York; **George McKinney, Jr.**, Assistant Vice-President, Irving Trust Company; **Charles Glavin**, Vice-President and Director, The First Boston Corporation; **Edward B. White**, Vice-President, First National City Bank of New York; **Frank D. Chutter**, Industry Specialist, Massachusetts Investors Trust; and **William A. Doyle**, Financial Writer, New York World-Telegram & Sun.

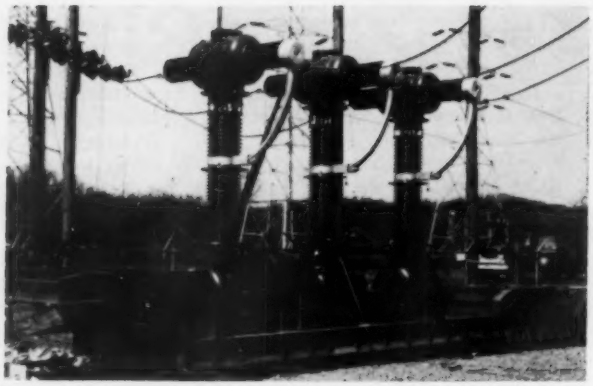
These financial experts jointly discussed ways and means of better financing for utilities. Each in turn highlighted the fact that the Federal economy is rising, and estimated that total financing for 1961, by large utilities, will total $1.6 billion. Two principal highlights came from this session on financing; one was the need for wider spread in utility stock ownership, and the other was the increasing demand by investors for higher earnings on utilities' stocks.

Dr. Albert L. Cole, Vice-President and General Manager of Readers' Digest, told the meeting that electrical companies, particularly, should attempt to make their image more understandable to the American public. According to him, too much has been done to create corporate images without first having defined company objectives — in terms of the man on the street's language.

AS A FINAL HIGHLIGHT of the Convention, **E. R. Acker**, Chairman of the Board, Central Hudson Gas & Electric Corporation, gave a preview of the utility industry exhibit which will appear at the New York World's Fair in 1964-65. Mr. Acker is chairman of the EEI World's Fair Committee. This exhibit is estimated to cost between $6 million and $7 million and will contain the greatest concentration of light ever assembled. An attractive model of the exhibit was on display.

The newly elected officials of EEI were indoctrinated in their new jobs at this meeting. **Mr. Philip A. Fleger**, Chairman of the Board and President of Duquesne Light Company, is the new president, and **W. W. Lynch**, President of Texas Power and Light, will serve as the new vice-president.

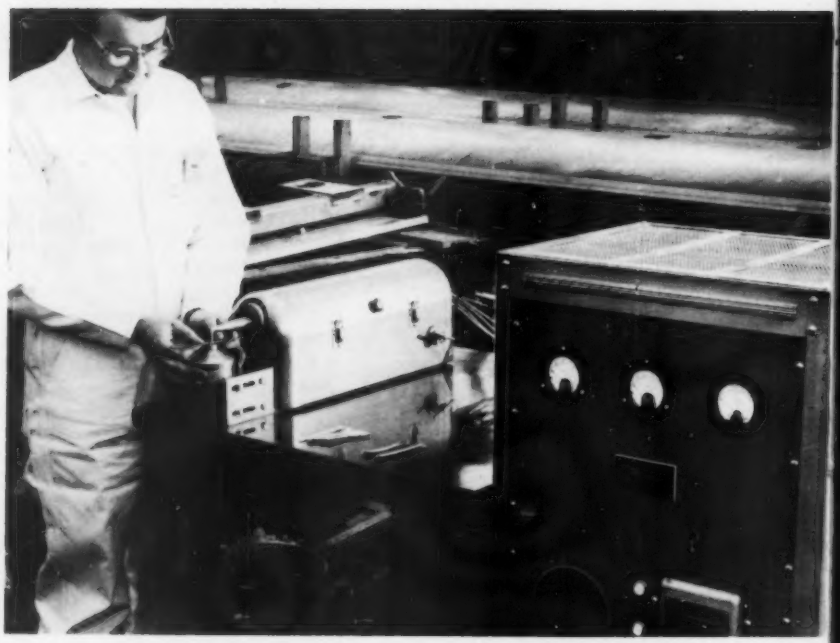
Congratulations go to Pennsylvania Electric Co. for winning the coveted Edison Award. This was given for the company's pioneering work in the PENELEC 460-kv project (see POWER ENGINEERING, p. 70, March 1961). END



138-kv GE air-blast breaker rests unbolted on bed truck during grueling two-cycle interruption tests held at AEP System's Philip Sporn Plant substation

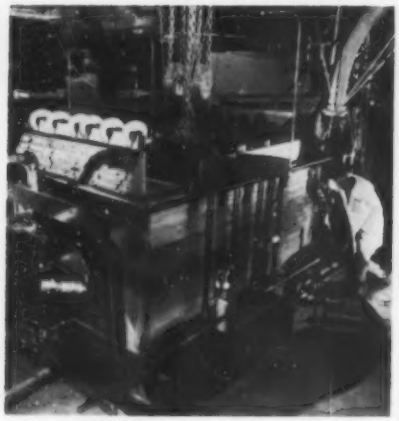
Valves hit Park Avenue in this elegant new showroom opened by Crane Co. across from Waldorf Astoria

Power Engineering's



Ultrasonic welding technique in use at Boeing Co. operates from 60-cycle power source but frequency is stepped up to 15,000-60,000 cycles, with acoustical energy doing the welding through rearrangement of the two metal structures into one

Mark II, Avco-Everett's experimental MHD power generator. The electromagnet consists of 25 tons of iron pole pieces and 22 tons of copper plates by Revere

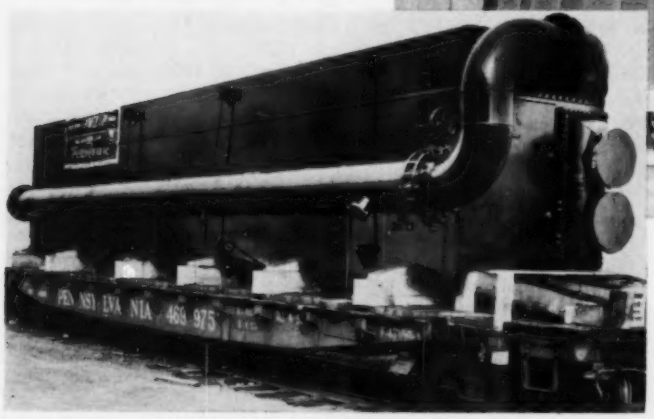


Rocky Reach has begun producing power. All seven generators in the $262-million project on the Columbia River are expected to be in operation by Nov. 1

NEWS REEL

24-billion candlepower tower of light based in a rainbow-colored building 80 ft high will mark electric utilities' exhibit at the 1964-65 New York World's Fair

Single-stage flash evaporator, said to be largest ever shipped in this country, goes from Westinghouse to TVA's Paradise Steam Station in Ky. It can produce 200,000 gpd



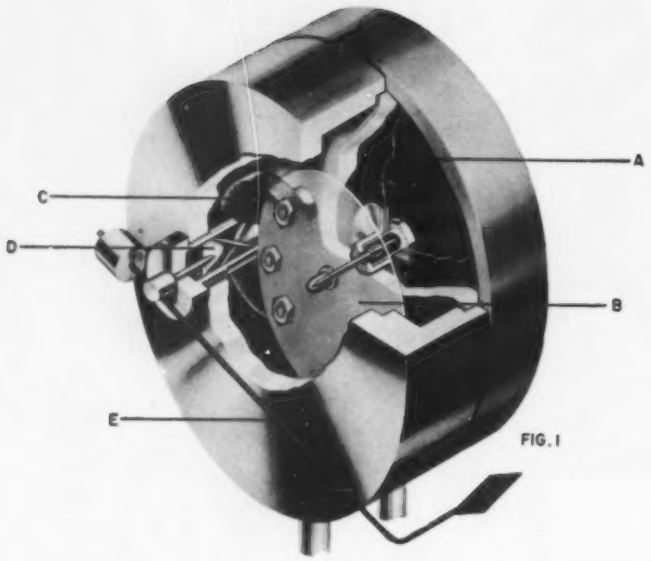


FIG. 1

ACCURATE LEVEL INDICATION FOR HIGH-PRESSURE BOILERS

R. A. Handschumacher and W. A. Huss, Engineers with Yarnall-Waring Co., describe modern indicators

HIGHER BOILER PRESSURES, temperatures and steaming rates present many problems to plant designers and operators. Designers face the problems of a dependable feedwater supply at all times and an accurate indication of how much water is in the steam drum. For operators there is the physical problem of seeing the water level indicator. As steam pressures, temperatures and boiler capacities rise, the steam drum is built higher and higher above the operating floor.

All proved water level indicators, such as gage glasses and water columns with floats to actuate alarms and trycocks, have their place in power boilers. But as the distance between the gage glass and operating floor increases, these devices need one or more auxiliary aids to ensure accurate reading.

Great distance between the drum and the operator's eye demanded a safe, dependable, accurate means of remote indication of steam drum water level. The remote indicator was not to replace the accepted standard of boiler water level reference, the gage glass reading. Instead, it was to serve as a supplement to the gage glass and was to operate in accordance with this standard. To meet these needs the remote liquid level indicator was developed.

Popular indicators are operated by the boiler water itself. The system in Fig. 3 uses the pressure differential between a constant head of water in the head chamber and the varying head of water in the boiler drum to actuate the pointer of a differential pressure indicator. The constant head chamber, or ambient temperature column, is located above the high water level and connected to the upper portion (steam space) of the drum. A connection is also made from the variable head leg to the lower portion (water space) of the drum. The level of the water in the constant head chamber is maintained by condensation in the steam space. Condensate formed in the chamber overflows into the variable head leg, and it is this overflow level which provides the constant static head.

Pressure created by the static head of water in the chamber is transmitted through the right-hand tube to one side of the indicator. The left-hand tube is connected to the lower fitting of the boiler drum and produces a variable static head on the indicator as the water level in the drum changes. Variations in the differential pressure (difference between the constant and variable pressures in the right- and left-hand tubes, respectively) cause a movement of the indicator pointer, which indicates the water level.

INDICATORS may be mounted on the boiler room instrument panel or installed at any other location convenient to the operator. In the differential pressure instrument (Fig. 1) the constant head tube is connected to the right side of the diaphragm (A) and the variable head tube to the left side. Change in dif-

ference between the two pressures moves the diaphragm which in turn through a deflection plate (B), a magnet (C) and a spiral magnetic armature (D) moves the counterbalanced pointer (E) across a graduated dial.

Water level glass reading has always been the accepted standard of boiler water level reference; a remote water level indicator, serving to supplement the water glass, should operate in accordance with this standard. Remote indicators for pressures of 0 to 700 psi are normally calibrated to gage conditions at operating pressures. Variations in indication due to pressure changes are comparatively slight. Tests show that the average temperature of water in a gage glass is always lower than the temperature in a boiler drum; the corresponding difference in water density would produce a visible level lower than the actual level in the drum.

In some cases the difference in level due to these variations is compensated by lowering the water gage with respect to the level in the boiler drum. Remote indicators are calibrated to conform closely to water glass readings at operating pressure under stable temperature conditions.

Error of the indicator reading at mid-scale with respect to the water gage would increase with increasing pressure; under actual operating conditions, however, steam from the boiler fills the constant head chamber and heats the water in this chamber and in the upper portion of the constant head tube running down to the indicator. This heating provides *natural compensation* by reducing the density of the water at this point, thus lowering its effective head on the constant head column and providing a higher indicator reading, which corresponds closely with the gage glass reading at mid-scale. Besides this natural compensation correction, there can be applied an additional correction by means of calibrating to the average density value.

FOR STEAM PRESSURES above 700 psi, where boiler water temperatures are relatively high, natural compensation is not sufficient for the necessary accuracy between the reading of the indicator and the water glass. On pressures above 700 psi, density changes due to increasing temperatures become sufficiently pronounced to require additional measures to maintain accuracy of indication. For these applications the constant head chamber is fitted with a temperature compensating unit (Fig. 2), thereby producing accurate readings at normal (mid-scale) water levels at all pressures and full scale indicator accuracy at the specified operating pressure. This unit is a controlled temperature column which retains the stability characteristics of an ambient temperature column even under conditions of radically changing boiler pressures.

Effect of density (Fig. 4): As boiler pressure increases, the density of the water decreases and density of steam increases, as shown in Chart 1. Both of these factors reduce the differential pressure at the indicator, and this in turn reduces the amount of pointer travel over the indicator dial. As boiler pressures go higher this reduction in pointer travel becomes increasingly pronounced, and special compensation is required to correct for it.

Since normal boiler water levels are usually carried at or close to mid-scale, this point may be selected as the ideal reference, and temperature compensation equipment can be designed to meet this specification. Chart 2 shows reduced pointer movement as pressure increases with an indicator calibrated with cold water. Temperature compensation divides the effect of density change, but this indication, accurate at cold condition, would not be satisfactory for a high-pressure boiler operating at constant pressure.

For accuracy of indication at any given boiler operating pressure, the indicator can be calibrated to provide full scale pointer movement at that pressure. Chart 3 shows these conditions for an indicator calibrated for accuracy at 2000 psi. At lower pressures, density increases and causes pointer overtravel; at greater pressures, density decreases, causing pointer undertravel.

Indicator accuracies as described

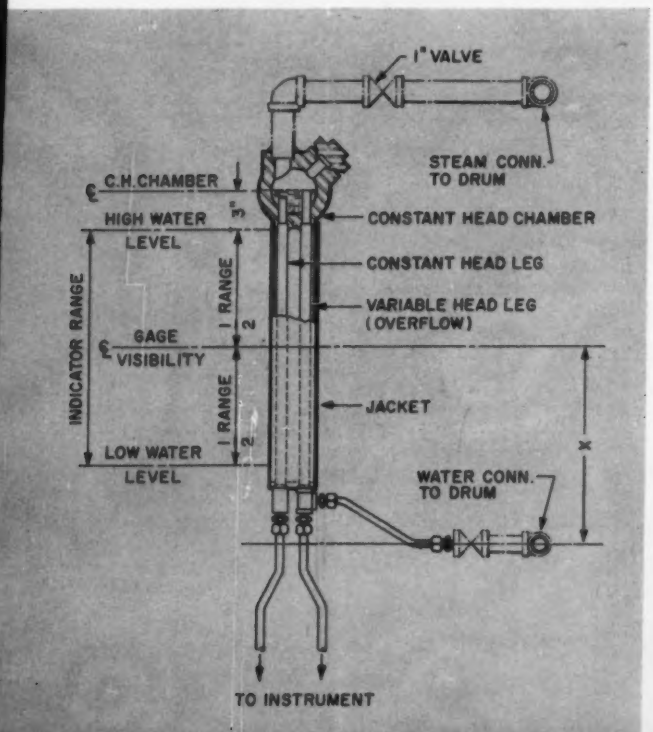


Fig. 2. Temperature compensating unit for boiler pressure range of 701 to 3000 psi

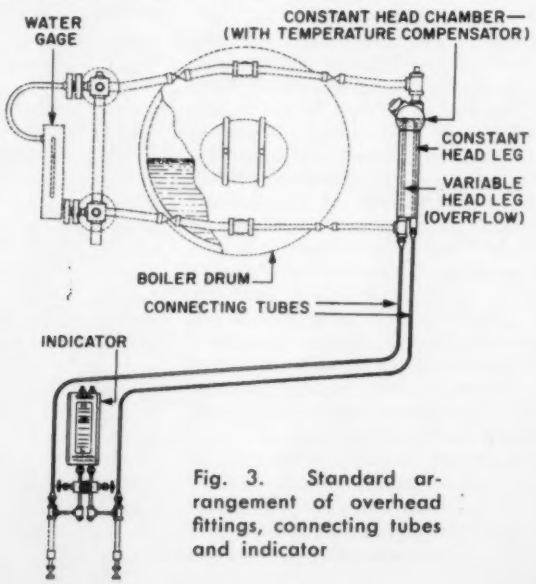


Fig. 3. Standard arrangement of overhead fittings, connecting tubes and indicator

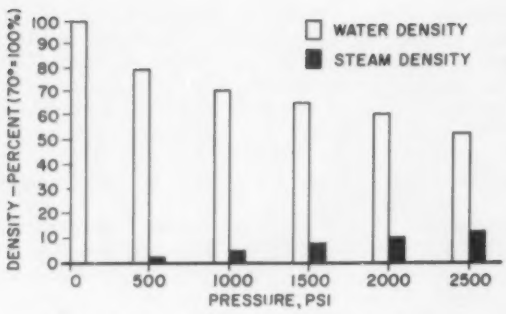


Fig. 4, Chart 1. Change in densities of water and steam with change in pressure

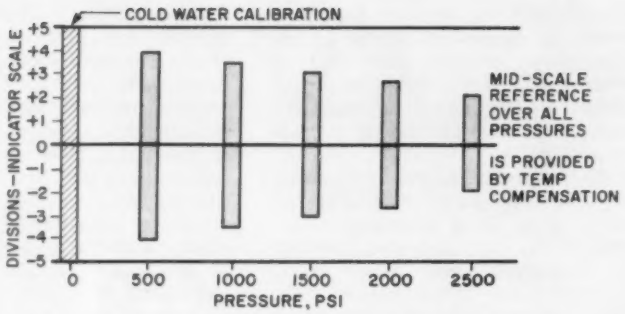


Chart 2. Pointer travel with temperature compensation, range calibrated for cold water (room temp)

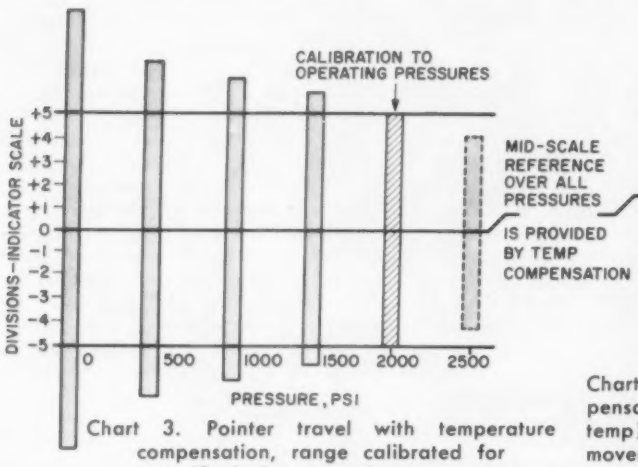


Chart 3. Pointer travel with temperature compensation, range calibrated for specific boiler operating pressure

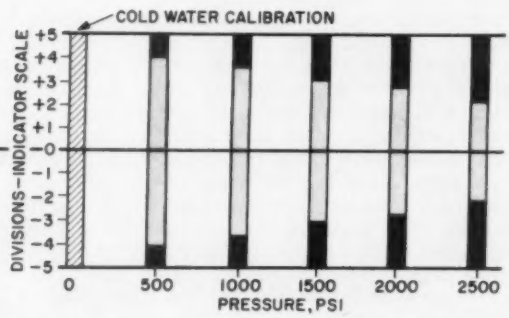


Chart 4. Pointer travel with temp and pressure compensation, range calibrated for cold water (room temp). Black areas show required additional pointer movement provided by pressure compensation

above are satisfactory for many installations. If, however, operating practices require accuracy over full indicator scale at all pressures, pressure compensation is necessary. Chart 4 shows how one type of pressure compensator provides additional pointer movement (black areas on gray bars) to correct for variation in density of water due to changes in boiler pressure. A compensator mechanism utilizes a bourdon tube (under boiler pressure) and suitable linkage which provides the pointer correction necessary for accurate compensation.

Code Case 1155: Prior to the Boiler Code Committee interpretation (Code Case 1155) of par. P-291, remote water level indicators were considered supplementary equipment. Since this interpretation, however, they can be used as primary indicators of boiler water level on high-pressure boilers to replace one of the two water gages previously used. The two water level indicators would preferably be connected to opposite ends of the drum. One water gage and one water level indicator may be connected to the same openings in the boiler drum.

Designers and operators are now using the Code Case 1155 approach to comply with the Boiler Code requirements while maintaining maximum efficiency with the greatest safety.

CHARTS 1 THROUGH 4, inclusive (Fig. 4), show conditions in the boiler drum and are related to drum level calibration. Calibration for gage level is based on temperature of the water in the gage where density changes are slight and pointer overtravel is small. Gage level calibration is preferred by some boiler operators since it provides a direct comparison and shows a level which is lower than the actual drum level. This approach gives added low water protection for the boiler but provides less protection under high water conditions where carry-over to the turbines can be a hazard. Drum level calibration provides the ultimate in boiler water level indication and is gaining in acceptance among boiler designers.

Secondary indication is frequently required when long distance transmission is necessary or when it is desirable to keep pressure connections away from the instrument panel. Primary indicators can actuate an electronic secondary of the standard or miniature size and still maintain their accuracy and independence of operation.

Where high and low level light, horn, and controls are required, the liquid level indicator can be provided to operate this equipment. Alarms and controls can be actuated either directly or through relays and amplifiers. They are used to start or stop a pump, motor, or any of a variety of other devices. By combining these controls with the remote transmission used in secondary or repeater type instruments, it is possible to achieve some advances toward automatic boiler operation. END

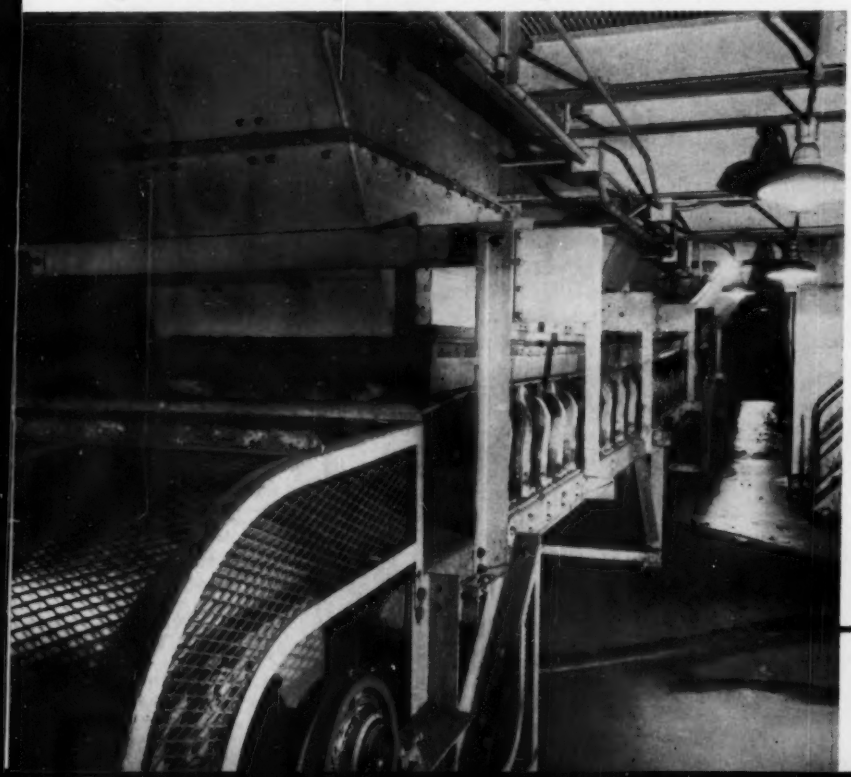
CONCLUDING THE STORY OF FROM MINE TO BOILER

A. S. Drummond discusses dust control, coal bunkers, and instrumentation. First of this set of six articles appeared in February

IN THE MODERN coal-handling system an essential requirement is the necessary equipment for dust control. This may run as much as five per cent of the cost of the coal-handling facilities. Dust removal eliminates a major cause of fire and explosion. It provides greatly improved working conditions and results in better job performance and reduced lost time.

Corrective action to suppress dust starts with the design of the system. This requires elimination of points of dust leakage. Feeders are enclosed. Discharge points of conveyors are hooded and have dust curtains covering the entrance to reduce the amount of air that may be drawn in. Skirts at the loading points of conveyors, Fig. 1, are covered and have double belt seals along the sides and dust curtains at the exit. All joints in the enclosures are gasketed. Belt cleaners are installed at the head pulleys to remove coal fines from the belt at the start of the return run.

Fig. 1. Conveyor loading enclosures are designed to keep down dust



Two methods of providing additional dust control are available. These are (1) collection of the dust by means of a suction system or (2) suppression of dust by spray wetting of the coal.

In the dust collection scheme a filter and exhauster are required, Fig. 2, with connecting ducts to all points in the coal-handling system where dust may be released. At loading and transfer points, the falling coal entrains air and tends to pump it down the chute. If it is not removed it will blow back through the entrance to the chute and disperse dust into the area. For this reason the dust-removing ducts are connected at the loading points of the conveyor belts.

Connections are also made to the discharge points of crushers and breakers and to the housing of the breakers. Each connection is equipped with a damper which is manually set to provide the amount of air flow necessary for removal of the dust from that point. The ducts from each connection are gathered into a manifold that connects to the dust filter. In addition to providing dust removal in the conveying and handling system, the dust collector also provides dust removal and scavenging of volatile gases from the bunkers. Removal of the volatile

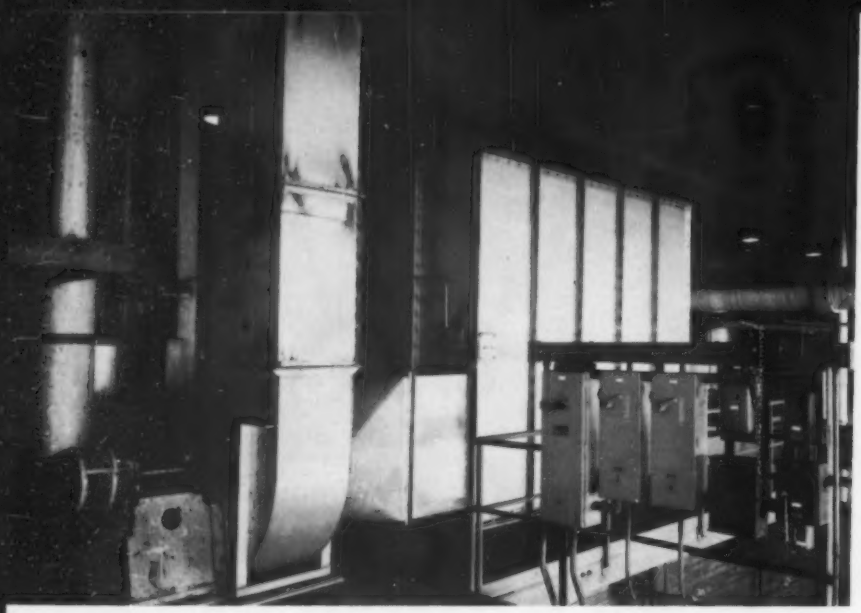


Fig. 2. Dust collector, exhaust fan connect with dust release points

gases is essential to prevent an accumulation with the possible result of an explosion.

The basic component of equipment used for spray control of dust is a proportioning regulator that adds wetting agent to the water entering a mixing tank. A pump takes its suction from the mixing tank and delivers the solution to spray nozzles at several points in the conveying system.

Coal from rail cars may be given the initial spray during the dumping operation. Coal from stock may be sprayed in the conveying system. Spray is usually added ahead of the breaker equipment and again at one or more points after the breaker to dampen the surfaces exposed as a result of the breaking action.

A frequent additional provision for improving housekeeping is to provide for washing down of the belt conveyor galleries.

COAL BUNKERS. The amount of coal stored in bunkers for gravity feed to the using equipment may vary from a few hours' supply to as much as 60 hours' supply. Average sizing is usually in the range of 24 to 30 hours' supply and results in bunkers of 3200 to 3800 tons capacity for steam generators of 125 tons per hour burning rate.

Using 12,000 Btu coal, this size will supply steam for a modern 325-Mw turbine-generator. With 500-Mw units in service and 800-Mw units being planned, the amount of coal required becomes very large. Because of these large quantities and the resulting size of the bunkers, use of reinforced concrete storage silos or active yard storage in the form of piles located over reclaim hoppers is increasing.

Active yard storage has large-volume advantages, but provisions must be made to guard against obstruction of the reclaim hoppers when reclaiming coal from winter storage.

In some cases a facility called a lowering well is used for gravity feed of the active yard storage to a reclaim hopper. This consists primarily of a cylindrical silo open at the top for admission of coal. Large ports in the wall of the cylinder allow the coal to spill out on the surrounding ground. A hopper at the bottom of the silo feeds the coal to a conveying belt as plant needs dictate. The conveyor may be started automatically on signal from bunker level devices or manually. As the coal lowers in the silo, coal from the surrounding pile spills back through the ports in the cylinder wall and feeds to the hopper.

A recent installation of this device is at the Breed Plant of the Indiana and Michigan Electric Co., where the lowering well is 135 feet high and six feet in diameter. Sufficient active storage is provided to supplement the bunkers adequately in the plan for week-end operation, thus permitting 5-days-a-week operation of the coal-receiving facilities.

Bunkers in the plant are normally of a rectangular shape with inverted pyramidal hoppers feeding the outlets. Gunite is applied to the vertical sides of the bunkers to protect the steel from corrosion. To facilitate movement of coal out of the bunker, the slopes of the hoppers may be lined with stainless steel. The valley angles where the adjacent sides of the slopes meet are preferably held to 55-deg minimum and have filler plates covering the valleys to provide wide angle corners. Other designs have been used, including parabolic shaped bunkers and cellular cylindrical bunkers in an effort to improve the strength and increase the amount of useful storage.

Use of the cellular cylindrical bunkers is particularly adaptable to automatic filling from active storage on signal from level devices in the bunker. In such an application the coal-conveying system is automatically started whenever the coal is lowered sufficiently in any cell of the bunker to actuate the low level device. Coal is fed into each cell in turn until all cells are filled. A full bunker device is then actuated to shut down the conveying system.

A great amount of work has been done to develop a feature that will facilitate the discharge of coal from a bunker under various conditions of coal sizing and moisture. One method of eliminating hang-up of coal above the hopper outlet is shown in Fig. 5. Inflatable rubber panels are mounted on the hopper slopes as

Fig. 3. Secondary hoppers under main bunker. Valves control coal flow

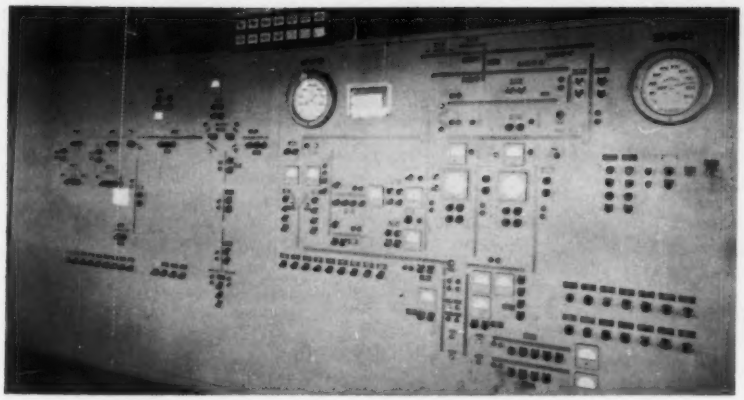


Fig. 4. Coal-handling control panel covers all equipment in system

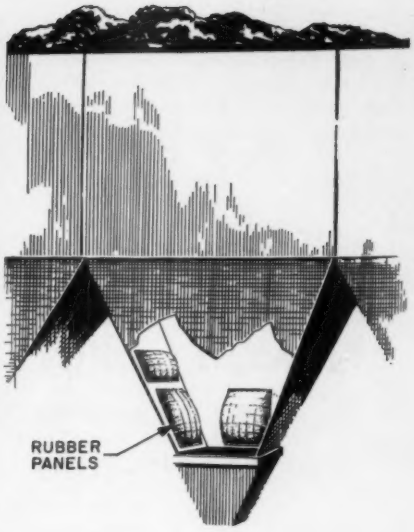


Fig. 5. Inflatable rubber panels in a bunker hopper break up bridging or arching

shown. The panels are inflated and exhausted by programming controls operating off the plant air supply. When inflated they push the coal over the hopper outlet opening and break up any bridging or arching effect, thereby providing a much larger working pocket. The weight of the coal in the bunker prevents bridging over of this large pocket area.

Other methods available may employ the use of electrical or air-driven vibrators, a special device in the outlet of the hopper developed by the Bituminous Coal Research Institute, which was described in *Combustion Engineering*, of November 1957, or a special form of hopper having parabolic convex slopes, which was originally developed in Formosa and was described in *Combustion Engineering* of January 1960.

Figure 3 shows secondary hoppers under the main bunker and coal valves at the connection of these hoppers to the coal pipes feeding the mills. The hoppers have hinged cover sections at the upper edge to permit observation of the coal and necessary poking to facilitate movement of bridged coal. These secondary hoppers permit the use of large openings from the main bunker so that the coal flows more readily to the hopper.

INSTRUMENTATION, POWER USAGE. Conveyors in a coal-handling system are interlocked to necessitate starting in sequence. When coal is to be put into the bunkers, distributing conveyors feeding the bunkers must be started first and then each preceding conveyor is started in turn back to the conveyor removing coal from the supply point. Coal breakers or crushers must be started before conveyors feeding them will start. The system is interlocked in this manner so that the trip-out of any conveyor will stop all conveyors back to the source of supply.

Alarms are normally provided that automatically sound before any conveyor starts to warn personnel in the area to stand clear. Push-buttons, or a pull-cord trip, are provided along the side of each conveyor for the operators' use in emergency. Magnetic separators are normally interlocked.

The central coal-handling control panel, Fig. 4, gives the operator supervisory control over all equipment in the system. Flow strips show all conveyor functions and the loading and discharge points. Start-stop control for all equipment is located in the flow pattern according to the relative position of the equipment. The service status is indicated by colored lights adjacent to each component unit.

Ammeters indicate the load on the conditioning equipment and on the feeders to permit necessary control to avoid overloading. The dials in the center of the right half of the panel indicate rotation position of the breakers, and in case of overload trip-out of a breaker containing a large amount of coal, the indicator permits the operator to "rock" the breaker in order to get it started. The large dials on the upper center and right side of the panel indicate the weight of coal being handled on each conveying system.

Installed power equipment in conveying and conditioning equipment is about two hp per ton per hour of coal-handling capability. Power usage is approximately one kwh per ton of coal consumed.

The modern coal-handling system providing reliable supply of fuel to today's power plants requires an investment of millions of dollars. Proper and judicious expenditure of this money means that consideration be given to the coal-handling requirements in the initial planning of the plant site. Considerable savings in capital investment may be realized by orienting a plant to meet its coal needs. END

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Newest facility for plasma research—the C-STELLARATOR

Leonard J. Linde, Director of Engineering, Industries Group at Allis-Chalmers, describes this "hot" unit

ADVANCED RESEARCH in the field of plasma physics is being conducted at Princeton University using the most modern research facility of its kind — the Model C-Stellarator. Working with extremely high-temperature gas, measured in the million-degree range, physicists are studying the characteristics of a plasma (an ionized gas) and its interactions and radiation.

C-Stellarator is a complex research tool consisting of an 8-in.-diameter racetrack-shaped stainless steel vacuum vessel encircled by coils that produce magnetic fields to contain and stabilize the plasma. During advanced research phases, the U-bends of this vessel are encircled by stabilizing windings that twist about the U-bends in a helical fashion. This winding produces a magnetic field that stabilizes the plasma in the center of the vessel by rotating the plasma as it passes around the U-bend. Encircling this winding and the rest of the vessel are the large confining field coils. These coils establish the fields that confine the plasma in a continuous cylindrical ribbon in the center of the vessel.

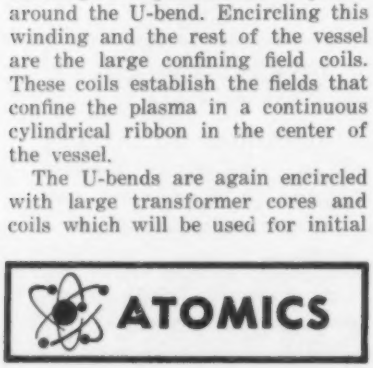
The U-bends are again encircled with large transformer cores and coils which will be used for initial heating. When the coils are energized, high current is induced in the plasma, causing it to heat due to its resistance. Final heating is accomplished by a coil inserted around a ceramic portion in a straight section of the vessel. This coil heats the plasma by "magnetic pumping" at radio frequencies which are resonances of the system. Impurities are removed from the plasma stream by a diverter, which will be inserted in the other straight section. The diverter scrapes off the outer layer of plasma and removes it from the vessel through the vacuum system.

The large amounts of direct current required for these coils will be supplied by flywheel-type motor-generator sets. This system is composed of three 7000-hp motors, three 96-ton flywheels and 12 d-c generators, the latter with a combined continuous rating of 48,000 kw at 600 v. Maximum peak rating with the present motors is 200,000 kw, 750 v. The power leveling influence of the 20-ft-diameter flywheels will hold peak power demands of the three 7000-hp motors to their rated full-load value.

SPECIAL FABRICATION. All coil cases, the vacuum vessel and the Stellarator supporting structure were fabricated from non-magnetic stainless steel. One reason for this was the critical requirements on the position of magnetic lines of force; another reason was the high strength requirements on the mechanical structure.

Magnetic forces are extreme at the axis of the coils, and forces between adjacent coils can reach 670,000 lb if any coil is accidentally open-circuited. During normal pulsed operation, the compressive force on the machine from end to end will reach over two million pounds. Under these loads, the mechanical deflection of coils and frame must not exceed 0.045 inches. Weighing over 170 tons, the Stellarator supporting structure is one of the most massive stainless steel frames ever fabricated.

Radio frequency equipment to heat the plasma is powerful and complex. When the gas to be studied is injected into the vacuum vessel, it must first be ionized. The nuclei must be stripped of their electrons so that they will be responsive to the electric and magnetic fields. This ionization is accomplished by imposing a pulse of energy at a breakdown voltage across the ceramic bulge section of the Stellarator. This pulse, at 100 kc to 250 kc, may have a peak power of 400 kw and a duration up to 10 milliseconds. Its power supply is large pulse and radio frequency generators.



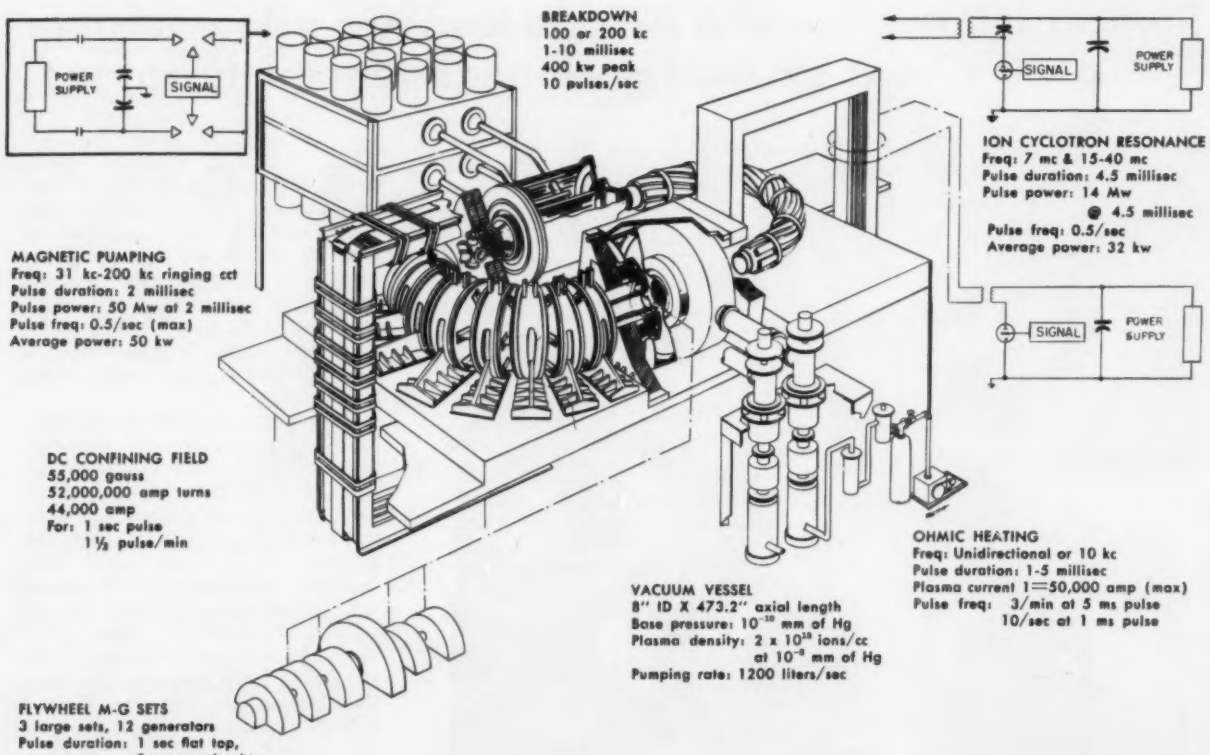
HEATING THE PLASMA. Once the gas is ionized, the confining field guides a continuous loop of plasma around the vessel. An ohmic heating generator heats the plasma by inducing high currents in this plasma loop. Six powerful vacuum tubes switch short pulses (from 1 to 5 milliseconds) of power from a capacitor bank with an energy storage capacity of 500,000 joules. Up to 50,000 amperes are induced in the plasma through the two large coupling transformers encircling the Stellarator U-bends.

When the plasma reaches a temperature of about one million degrees, its conductivity reaches that of a metal conductor, and heating by resistance is no longer effective. To reach higher temperatures, one of two radio frequency systems will be employed. The plasma nuclei may be agitated by "magnetic pumping" at a frequency of 30 kc to 200 kc. To accomplish this, a "ringing" circuit will supply up to 100,000 joules of energy to coils encircling the ceramic bulge. This energy will result in radio frequency fields reaching 10,000 gauss at the axis of the bulge. Peak currents of 700,000 amperes are expected in the coils.

Alternately the plasma may be heated by exciting it at the ion cyclotron wave resonance, a frequency close to that of the circular rotation of the nuclei in the confining field. A radio frequency generator will supply power in pulse lengths of one to nine milliseconds. Because of the greater efficiency of this heating method, the power output will be in the range of 14 megawatts.

ULTIMATE GOAL. This facility, designed and constructed in accordance with Princeton concepts by Allis-Chalmers and RCA, is one of several research projects sponsored by the Atomic Energy Commission under the code name of "Project Sherwood." The ultimate goal of this project is to develop the means to apply controlled thermonuclear reactions for power generation. Through the efforts of these research programs, it is hoped that sufficient data on the characteristics of plasma and its interactions will be obtained to permit the future construction of a fusion-reaction power plant.

The Model C-Stellarator is one step forward toward this goal. It will not produce power and it was not intended to do so; it is a research facility. However, the experience gained in constructing this facility and the scientific data obtained during its operation will be extremely valuable when at some future date a true power-generating fusion-reaction plant is built, perhaps a Model D-Stellarator. END



ATOMICS

APPLE GROVE'S 775 KV GO "ON THE AIR"

Radio influence and corona loss are prime targets of five-year extra-high-voltage feasibility study

WHEN THE extra-high-voltage test transmission line at Apple Grove, West Virginia, was energized on June 22 at 775 kv, it marked the start of a five-year research and test program in which power engineers expect to determine the technical and economic feasibility of bulk power transfer at voltages up to 750 kv.

Co-sponsors American Electric Power Service Corp. and Westinghouse Electric Corp. thus extend their investigations begun at Brilliant, Ohio, in 1946, when they built and operated the 500-kv Tidd test project.

Other companies participating are: American Bridge Div. of United States Steel; Armco Steel Corp.; Kaiser Aluminum and Chemical Corp.; Lapp Insulator Co., Inc.; Ohio Brass Co.; and The Thomas & Betts Co., Inc.

D-c transmission must wait for economic necessity here, AEP President Philip Sporn tells Power Engineering's John Tyner. A. C. Monteith agrees. Above, pointed-base guyed H-frames save half required station steel

Each line section has six RI monitoring positions. Fiberglass instrument houses contain RI meters, whose information is fed to the Prodac data logger. Pictures below show the types of radio noise meters used

Energizing ceremony speakers included Governor William W. Barron of West Virginia, who pushed the energizing button; Philip Sporn, AEP president; A. C. Monteith, vice-president of Westinghouse and general manager of its apparatus products division; and R. E. Hodges, vice-president and general manager, Appalachian Power Co.

Mr. Sporn said, "We expect at the end of the five-year test period to be in a position to project, design and construct transmission lines at voltage levels as high as any that may be necessary to meet the needs of the country between now and the year 2000."

According to A. C. Monteith, "The accumulated information and data will be available not only to Westinghouse . . . not only to American Electric Power . . . not only to the six other companies participating in this project . . . but to all industry as well."

Mr. Sporn mentioned in a press conference following the ceremonies that the line will be used in a year or two to do more research on bare-hand hot-line maintenance.

PRIME OBJECTIVE is to obtain data on corona loss and radio influence performance of conductors at 750 kv nominal.

Information on conductor size and configuration, insulators, spacers, bushings, connectors, hardware, and structural data will be of value in determining future line design. Operating experience with transformers, lightning arresters, coupling capacitors, and line traps will help in the future design of 750-kv terminal apparatus.

Located on a possible future generating site of Appalachian Power Co., about 25 miles up the Ohio River from Huntington, West Virginia, the line taps a double-circuit 138-kv line between South Point, Ohio, and the Philip Sporn plant at Graham Station, West Virginia. The tap feeds the test line through a three-pole load-break disconnect switch to the 138/750-kv autotransformer and then to a 750-kv bus structure. Originating at the substation bus and extending from it are three 2400-ft-long three-phase lines, forming a "T". (See map.) The control and instrument house is located in the 138-kv switchyard.

Based on experience at Tidd and Leadville and other high-voltage projects, calculations were made to select the best conductor size in four-unit bundles for 750-kv operation. One of the three line sections uses 1.382-in.-diam ACSR. The second section uses 1.196-in.-diam ACSR on all three phases. The third line uses a combination of the two sizes; the outer phases have the smaller cable; the center phase, the larger, since this conductor has greater voltage stress on its surface.

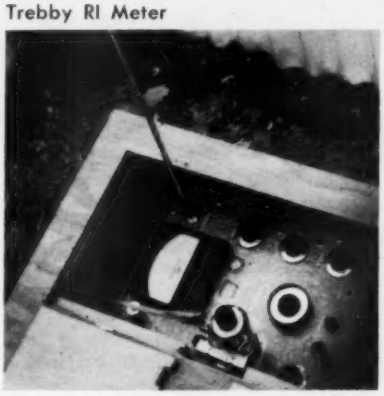
SPECIAL FEATURES allow simultaneous independent RI readings to be taken on each of the three lines; and, since no load is supplied by the line, provide heating current to simulate actual system operation.

Decouplers between the three lines minimize interaction of the radio noise generated on one line section with respect to that produced on another line section.

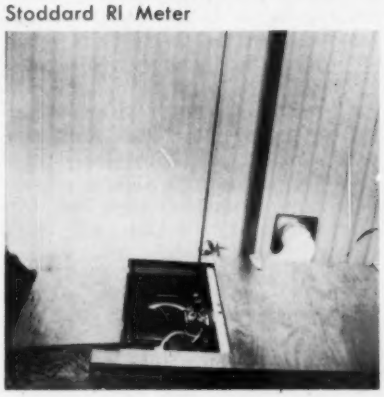
The four conductors in each phase bundle are insulated from each other for 420 v, but are connected in series. Current is circulated through them from a transformer at the station end of each phase. A series capacitor used with each transformer maximizes current. Conductor heating is equivalent to over 1,000,000-kva load.

While each conductor in the bundle is isolated for 60-cycle current, by-pass filters at the line terminals keep all conductors at the same po-

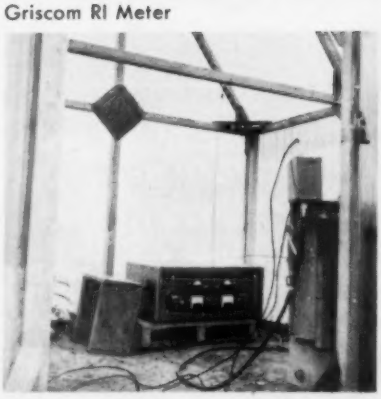
Trebby RI Meter

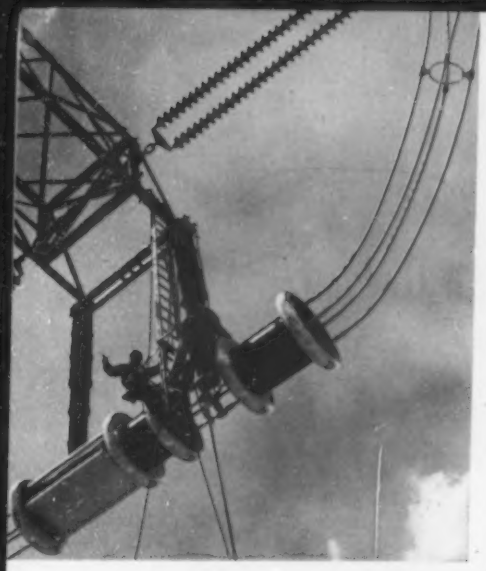


Stoddard RI Meter



Griscom RI Meter





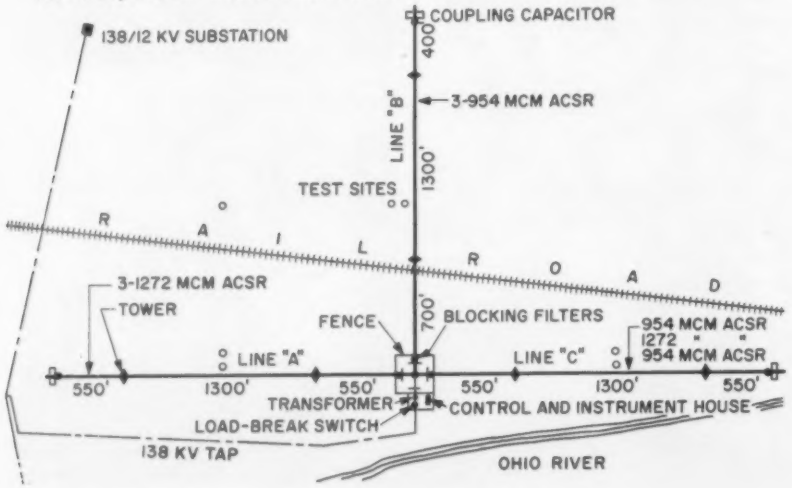
Decoupler houses: (l-r) corona loss wattmeter, heating transformer and series capacitor. Spools are chokes

tential for radio-frequency currents.

Tests will be completely instrumented, using Prodac magnetic-tape data-logging equipment to allow maximum information to be accumulated and analyzed. Effects of various atmospheric conditions will be assimilated into this data for proper statistical analysis. Comparison of the Apple Grove data with that of previous high-voltage projects will allow evaluation of test procedures, instrumentation, and verification of results.

Readings of about 50 test quantities will be taken by the data logger and recorded every 20 minutes. Whenever test readings fall outside predetermined limits, the data logger will scan and record readings every two minutes until the values fall back into line. The logger can digitally accumulate 60 days of operational data on one tape. The tape is compatible with the IBM 7090,

Schematic shows "T" shape of line for independent measurement sites



thus permitting fast and flexible analysis of data.

Readings will include: temperature, relative humidity, air pressure, wind direction and velocity, radio influence, corona loss, rainfall, and air contamination.

RI WILL BE MEASURED at 18 locations. Six instrument houses are located at the approximate midpoint under each of the three line sections. Three under each line are located 100 ft from the center phase; the other three, 200 ft from the center phase. Three additional meters are located about 500 ft away to measure ambient radio effects, whether from radio transmitters or atmospherics.

Corona-loss wattmeters, located in each phase, record energy loss by using the voltage from a one-turn tap at the high-voltage end of the 750-kv transformer winding, and the in-phase component of current into the test lines. An ultrasonic beam links corona-loss measuring equipment to the data-logging equipment.

Contamination readings come from a conventional smoke photometer and a new device which uses a high-voltage rod. Dirt particles in the air approaching the high-voltage rod cause breakdown of the air around the rod, and the amount of resulting RI noise can be measured and compared with test-line performance.

EQUIPMENT AND SERVICE were supplied by the following companies:

American Electric Power Service Corp. designed and engineered the lines and substation, furnished the project site and provides the power to carry out the tests.

American Bridge Div. of United States Steel Corp. supplied the steel towers and substation structure.

Armco Steel Corp. used about 160,000 lb of 12-mil Armco M-5 grain-oriented electrical steel in the autotransformer core.

Kaiser Aluminum & Chemical Corp.'s 130,000 ft of ACSR weigh about 80 tons. The Trebby RI meter was developed by F. J. Trebby in the Dept. of Metallurgical Research.

Lapp Insulator Co.'s suspension insulators, hardware, and grading devices for the suspension and dead-end assemblies are on test line B.

Ohio Brass Co. supplied the suspension and dead-end assemblies (including insulators, hardware, and control shields for test lines A and C), bundle spacers for all test lines and station, and suspension assemblies for the 138-kv feeder.

The Thomas & Betts Co., Inc. supplied extra-high-voltage compression-type cable accessories for splicing, dead-ending, tapping, and terminating.

These are the contractors: St. Albans Builders Supply Co., Rao Elec. Eqpt. Co., Collier Const. Co., and Am. Steel and Wire Div., U.S. Steel Corp.

WESTINGHOUSE has a wide range of its equipment on the line. The 138-kv, 600-amp, SF_6 load-break switch connects the supply to the autotransformer. A 15-cycle 138-kv conventional swinging-blade grounding switch protects the equipment area.

The 125,000-kva, inner-cooled, 138/750-kv, three-phase autotransformer has taps for 687.5, 625, 562, and 500 kv. It will be used by AEP at 345 kv at the conclusion of the test period by paralleling sections of the high-voltage winding.

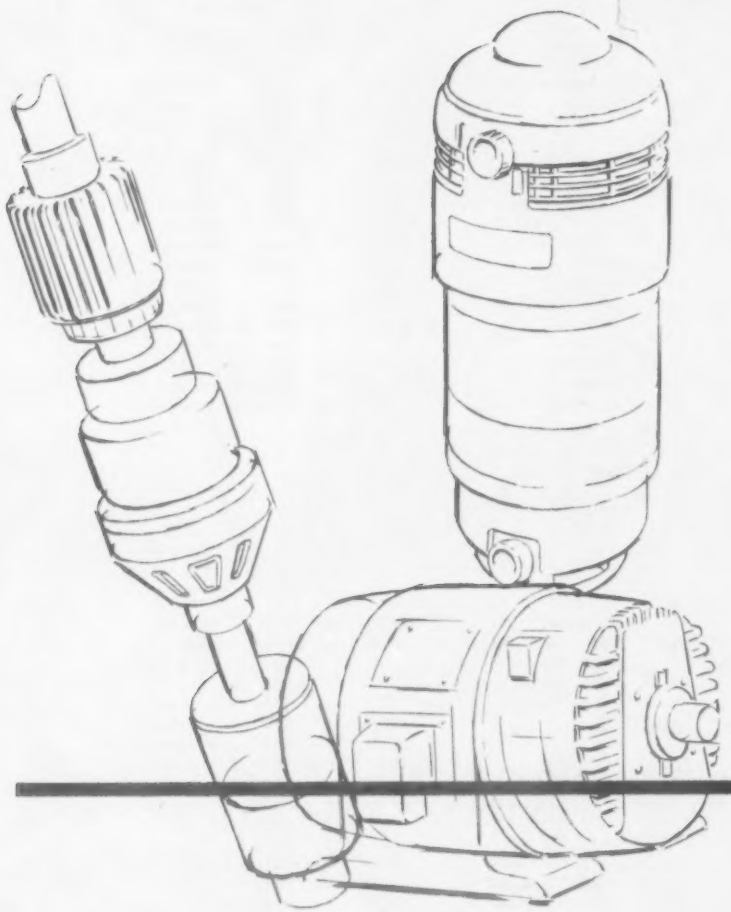
Three 528-kv station-type lightning arresters on the transformer's high side protect the 750-kv windings. An insulating base unit is included to permit measurements of lightning arrester grading currents, and for installation of operation counters.

Decouplers are T networks. Each has a two-milhenry choke in series with a five-milhenry choke, and an 830-mmfd capacitor connected from the midpoint between the two chokes to ground.

The Griscom RI meter was developed by S. B. Griscom of the Electric Utility Eng. Dept. END

MOTORS FOR A STEAM PLANT

Earle M. Sommerfield, of United Engineers and Constructors, Inc., provides an interesting summary of motors used in a typical steam power plant



SUCCESSFUL INSTALLATION of motor-driven equipment requires proper selection of the machine, the motor and the controller. Operating requirements of the machine determine the necessary motor characteristics, while location determines the enclosure to be used. Control apparatus must be matched to the motor to ensure its performance of the functions required of it.

In the April 1961 issue of POWER ENGINEERING, Mr. Sommerfield's typical list of starter needs was presented. Now, here is listed the motor needs of a typical plant comprising two 75-Mw units 1800 psig, 1000/1000 F, natural circulation boiler, hydrogen-cooled stator, separately driven exciter, and motor-driven steam soot blowers.

Motor horsepower will depend upon conditions such as pressure and capacity. Enclosure, speed, voltage and location may depend upon designer's preference, voltage available, and local conditions.

Use this table to estimate motor requirements of power plant

MOTOR LIST—Typical Steam Power Plant, Two 75-Mw Units

Service	Quantity Unit 1	Quantity Unit 2	HP	Type	Speed	Voltage	Location
BOILER HOUSE:							
Boiler Feed Pump	2	2	1500	Dripproof	3600	4160	Indoors
I.D. Fan	2	2	900	Weatherproof	900	4160	Outdoors
F.D. Fan	2	2	300	Dripproof	900	4160	Indoors
Coal Mill	3	3	250	Dripproof	600	4160	Indoors
Coal Scale	3	3	1	TENV	1800	4160	Indoors
Coal Feeder	3	3	2/1	Dripproof	1800/900	480	Indoors
Coal Mill—Air Seal Blower	1	1	5	Dripproof	3600	480	Indoors
Main Steam Valve	1	1	1	TE	1600	480	Indoors
L.P. Heater Drain Pump	2	2	40	Dripproof	3600	480	Indoors
Ignition Oil Pump	2	1	5	Dripproof	1800	480	Indoors
Emerg. Firing Oil Pump	2	1	40	Dripproof	1800	480	Indoors
Air Preheater Circ. Oil Pump	2	2	¾	Dripproof	1800	480	Indoors
Air Preheater	2	2	5	Dripproof	1800	480	Indoors
Fuel Oil Transfer Pump	2		7½	TEFC	1800	480	Indoors
Coal-Sampling Crusher	1		3	TEFC	1200	480	Indoors
B.F.P. Aux. Oil Pump	2	2	1½	Dripproof	3600	480	Indoors
Soot Blowers	27	27	1/6	TENV	1800	480	Indoors
Soot Blowers	4	4	¼	TE	1725	480	Indoors
Soot Blowers	8	8	1½	TENV	1730	480	Indoors
H.P. Heater Drain Pump	1	1	20	Vertical Dripproof	3600	480	Indoors
TURBINE ROOM:							
Main Exciter	1	1	400	Dripproof	1200	4160	Indoors
Spare Exciter	1	1	400	Dripproof	1200	4160	Indoors
Loop Seal Vapor Extractor	1	1	1	Expl. Proof TEFC	1200	480	Indoors
Lube Oil Transfer Pump	1	1	5	TEFC	1200	480	Indoors
Dirty Oil Transfer Pump	1		1	TENV	1200	480	Indoors
Turbine Lube Oil Filter Circulating Pump	1		¾	TENV	1800	480	Indoors
Seal Oil Supply Vacuum Pump	1	1	3	Expl. Proof Gear Motor	1800	480	Indoors
Main Seal Oil Pump	1	1	3	Expl. Proof Gear Motor	1800	480	Indoors
Turbine Oil Vapor Extr.	1	1	2	Expl. Proof TEFC	1200	480	Indoors
Turbine Aux. Oil Pump	1	1	40	TEFC	1200	480	Indoors
Gland Condenser Exhauster	1	1	2	TEFC	3600	480	Indoors
Mag-A-Stat	1	1	20	Dripproof	1800	480	Indoors
Turning Gear Drive	1	1	15	Dripproof	1800	480	Indoors
Turning Gear Aux. Oil Pump	1	1	10	Dripproof	1800	480	Indoors
Turbine Room Crane:							
Main Hoist	2		25	Dripproof	900	480	Indoors
Trolley	2		5	Dripproof	1200	480	Indoors
Trolley	1		25	Dripproof	900	480	Indoors
CONDENSING:							
Circulating Water Pump	2	2	250	Vert. Dripproof	600	4160	Indoors
Condensate Pump	2	2	200	Vert. Dripproof	1800	480	Outdoors
Traveling Screen	2	2	1½	TENV	1800/900	480	Outdoors
Circ. Water Pump Valve	2	2	1	TENV	1750	480	Indoors
Hotwell By-pass Valves	3	3	1	TENV	1750	480	Indoors
WATER TREATMENT:							
Treated Water Booster Pump	2		20	Dripproof	3600	480	Indoors
Caustic & Sulphite Pump	1		½	TENV Gear Motor	1725	480	Indoors
Phosphate Pump	2		2	Gear Motor	1725	480	Indoors
Caustic Pump	2		½	Gear Motor	1725	480	Indoors
Sulphite Pump	2		½	Gear Motor	1725	480	Indoors
Oxygen Analyzer Washer & Pump	1		¾	TE	1800	480	Indoors
Chemical Mixer	1		⅓	TE	1800	480	Indoors
Boiler Fill and Drain Pump	1		20	Dripproof	3600	480	Indoors
Treated Water Transfer Pump	2		25	Vert. Hollow Shaft Dripproof	1800	480	Indoors
Chemical Waste Sump Pump	2		1	TE	1800	480	Indoors
Backwash Pump Water Filter	1		10	Vert. Hollow Shaft Dripproof	1800	480	Indoors
Alum Agitator	1		¾	Open-Dripproof	1800	480	Indoors
Lime Pump	1		1½	Open-Dripproof	3600	480	Indoors
Lime Agitator	1		⅓	Dripproof	1800	480	Indoors
Alum Pump	2		1	Open-Dripproof	3600	480	Indoors
Demineralized Water Transf. Pump	1		15	Dripproof	1800	480	Indoors
Degasifier	1		1	TEFC	3600	480	Indoors
Coagulating Tank:							
Recirculator	1		1	Dripproof	3600	480	Indoors
Scraper	1		¼	TE	1800	480	Indoors

MOTOR LIST—Typical Steam Power Plant, Two 75-Mw Units

Service	Quantity Unit 1	Quantity Unit 2	HP	Type	Speed	Voltage	Location
COAL AND ASH HANDLING:							
Ash Sluice Pump	1	1	200	Vert. Weather Protected	1800	480	Outdoors
Dust Removal Vibrators	8	8	¼			480	Indoors
Conveyor Drive	1		75	TEFC	1800	480	Indoors
Tripper	1		10	TEFC	1800	480	Indoors
Tripper Traverse	1		2	TEFC	1800	480	Indoors
Coal Sampling Cutter	1		¾	TEFC	1150	480	Indoors
Coal Crusher	1		250	TEFC	900	480	Indoors
Apron Conveyor	1		7½	TEFC	1800	480	Indoors
Coal Conveyor	1		25	TEFC	1800	480	Indoors
Stockout Conveyor	1		10	TEFC	1800	480	Indoors
Magnetic Sep. Conveyor	1		2	FC	1800	480	Indoors
Car Quake	1		25	TEFC	1200	480	Indoors
Car Puller	1		10	TENV	1200	480	Indoors
Clinker Grinder	1		5	Reversing	1200	480	Indoors
PLANT SERVICES:							
Office Exit Fan	1		2	TEFC	1800	480	Indoors
Weld Area Exhaust Fan	1		¾	Open	3600	480	Indoors
Office Air Conditioning:							
Exhaust Fan	1		2	TEFC	1800	480	Indoors
Compressor	1		25	TEFC	1800	480	Indoors
Fan	1		7½	TEFC	1800	480	Indoors
Cond. Pump	1		½	TEFC	3600	480	Indoors
Machine Shop:							
Engine Lathe	1		5	Dripproof	1800	480	Indoors
Engine Lathe	1		1½	Dripproof	1800	480	Indoors
Shaper	1		5	Dripproof	1800	480	Indoors
Radial Drill	1		1½	Dripproof	1800	480	Indoors
Power Drill	1		1	TE	1800	480	Indoors
Metal Sawing Machine	1		½	Open	1800	480	Indoors
Bench Grinder	1		1	TEFC	1800	480	Indoors
Milling Machine	1		3	Dripproof	1800	480	Indoors
Milling Machine	1		¼	Dripproof	1800	480	Indoors
Service Water Pump	3	1	125	Vert. Weather Protected	1800	480	Indoors
Fire Pump	1	1	200	Vert. Weather Protected	1800	480	Indoors
Station Air Compressor	2	1	50	Dripproof	1200	480	Indoors
Office Bldg. Supply Fan	1		2	TEFC	1800	480	Indoors
Service Water Pump		1	200	Vert. Weather Protected	1800	480	Indoors
Instrument Air Compressor	2	2	40	Dripproof	1800	480	Indoors
Bearing Cooling Water Pump	2	2	15	Dripproof	1800	480	Indoors
Heating Condensate Pump	1	1	½	Dripproof	3600	480	Indoors
Jet Pump	1		½	TE	3600	480	Indoors
Monorail Hoist	1		5	TE	1200	480	Indoors
Vent Fan	1		½	TE	1200	480	Indoors
Swgr. Room Supply Fan	1	1	5	TEFC	1800	480	Indoors
Deepwell Pump	1		7½	Vert. Hollow Shaft Dripproof	3600	480	Indoors
Deepwell Pump	1		15	Vert. Hollow Shaft Dripproof	1800	480	Indoors
House Service Boiler:							
F.D. Fan	1		15	Dripproof	3600	480	Indoors
Oil Pump	1		1½	Dripproof	1200	480	Indoors
Feedwater Pump	1		5	Dripproof	1800	480	Indoors
Roof Vent Fan	2		¾	N.V. Dripproof	900	480	Indoors
Boiler House Vent Fan	6	6	15	Reversible TEFC	900	480	Indoors
Elevator M-G Set	1		30	Dripproof	1800	480	Indoors
Vent Fan	1		¼	TEFC	1800	480	Indoors
Sump Pump	2		1	TE	1200	480	Indoors
Battery Room Vent Fan	1		¼	TE	1800	480	Indoors
Control Room Air Conditioning:							
Compressor	2		15	TEFC	1200	480	Indoors
Supply Fan	2		3	TEFC	1800	480	Indoors
Recirc. Fan	1		¾	TEFC	1800	480	Indoors
Vacuum Cleaning System	1		15	Dripproof	3600	480	Indoors
Battery Charging M-G Set	1	1	15	Dripproof	1200	480	Indoors
Microwave Equipment	1		10	Dripproof	1800	480	Indoors
Microwave Equipment	1		7½	D.C.			Indoors
Roof Vent Fan	1		¼	TEFC	1800	480	Indoors
TOTAL MOTORS:	208	116					
Above 200 hp	14	13					
200 and Below	194	103					

NUCLEAR POWER PLANT TAKES TO THE AIR

PM-1 is being airlifted to remote Air Force base. George Zindler, of The Martin Co., tells the story

PORTABLE NUCLEAR POWER PLANT, packaged for air delivery, has been produced by The Martin Co. under contract with the U.S. Atomic Energy Commission. It's called PM-1, a designation which means "portable," "medium power range," "plant number 1." The plant is being installed at Sundance Air Force Station in Wyoming, and it took 16 plane-loads to make the delivery from Baltimore to there.

Each plane load or plant module is limited to envelope dimensions of 8 ft 8 in. by 8 ft 8 in. by 30 ft to fit within a C-130 aircraft.

Using a fuel core about the size of a single oil drum, the plant is designed to operate for two years at full power before refueling. It will generate 1000 kilowatts net of electricity — enough for an average civilian community of about 2000 people — and will also deliver 7000 lb per hour of low-pressure steam to heat buildings. Millions of gallons of diesel oil would be required to match its output.

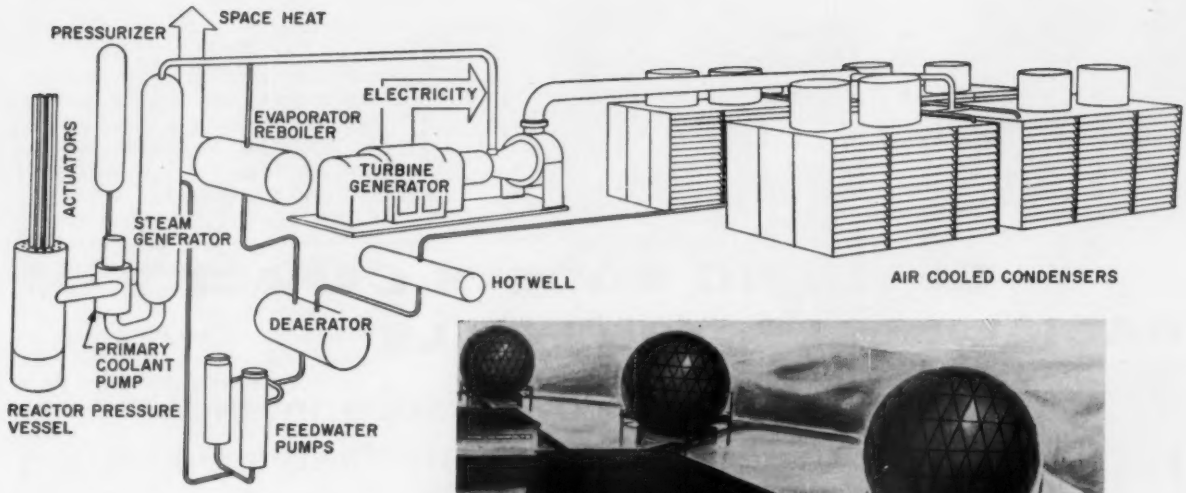
Prefabricated buildings to house PM-1 have been erected on a plateau near the top of Warren Peak, where the Air Force is building a radar station. It will take less than three months to install and interconnect the 16 packages and get the plant ready for operation this fall.

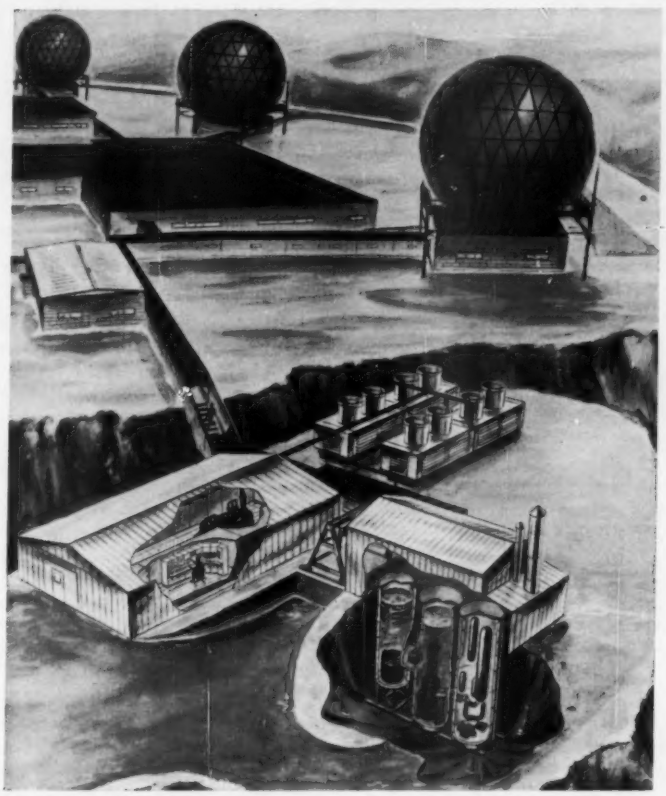
PM-1 will be the first nuclear power plant to serve an operational Air Force station, and will be staffed by specialist personnel from all three military services.

The PM-1 complex includes a fully pre-assembled decontamination and maintenance facility, modular evaporative radioactive liquid waste disposal system, and a spent-fuel storage facility. The reactor is of the pressurized-water type.

In the PM-1 plant, heat dissipation is accomplished by direct steam-to-air condensers designed and developed to produce the required amount of cooling over an ambient air temperature range of 70 F to −60 F.

The PM-1 primary system is contained in two cylindrical tanks of 8-ft 8-in. diameter and 30 ft long, constructed of high alloy steel. A third tank connected by a passageway to the reactor tank serves as a storage area for irradiated fuel. A lightweight steel structure is used to support these tanks, the primary system building, and the gantry crane (which is used to erect the





PM-1 nuclear power plant will generate 1000 kw net. Cutaway shows plant as it will look installed at Sundance Station

tanks initially and for maintenance and refueling thereafter). Local aggregate is placed around the primary system tanks to provide secondary shielding.

The reactor tank contains the pressure vessel, reactor control elements, instrumentation, and primary shielding. In operation it is filled with water, which serves as shielding in the vertical direction. A specially designed, weight-optimized lead and water shield surrounding the pressure vessel provides radial shielding.

The second large-diameter tank is operated dry and contains: (1) a vertical steam generator of Inconel-type construction; (2) a canned motor pump; (3) the vertical pressurizer; (4) high-pressure demineralizer for continuous purification of the primary loop water; (5) expansion tank; (6) 6-in. diameter 316 stainless steel primary piping.

THE ACTIVE CORE in the pressure vessel is a cylinder of 22.8-in. diameter and 30 inches long. Six peripheral pie-shaped bundles and one central hexagonal bundle make up the core. Because the reactor must be refueled in a minimum of time, the core is designed to permit refueling as a single unit.

For flexibility, refueling by individual bundle is also possible. The core contains 741 tubular fully enriched UO_2-stainless steel cermet-type fuel elements of 0.500-in. OD.

Coolant at 1300 psia and 2125 gpm flows in a single pass through both the inside and outside of the fuel tubes. Local boiling is permitted in the core, which has an average and maximum heat flux of 72,000 and 286,000 Btu/ft^2 hr respectively. Control is provided by six Y-shaped control rods using EU_2O_3 stabilized against hydration by TiO_2 as poison material.

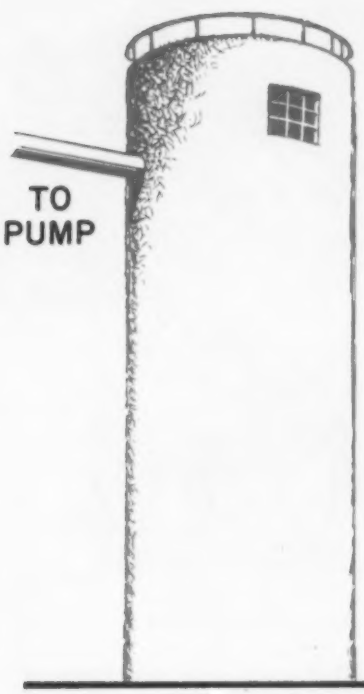
Ninety ½-in. OD natural boron stainless steel alloy lumped burnable poison rods are distributed throughout the core, which has a total fuel loading of 29.2 kg of U^{235}. Sufficient control margin is provided so that the reactor can be shut down with one rod stuck fully out or two stuck in the operating position.

Nuclear controls and instrumentation, as well as all other plant instrumentation, are centralized in one console and are of the all-electric, solid-state type. The control room is prefabricated as a complete module for air shipment.

Electrical output of the PM-1 is of high quality. The voltage and frequency output are designed so as not to vary more than ±2 per cent when the plant is subjected to a 30 per cent step load change. The plant is required to re-establish steady-state operation within 1½ seconds. Under steady-state conditions, frequency fluctuations are not to exceed ±0.25 per cent and voltage fluctuations are not to exceed ±0.5 per cent. These quality requirements permit the operation of sensitive radar equipment without additional filters and regulators. END

CLEANING BOOSTS CAPACITY OF RADIAL-COLLECTOR WELLS

American Cyanamid Power Superintendent Bernard Bowser describes this profitable operation



CAN A WATER WELL of the type known as the radial-collector be restored to its initial capacity after output has declined 40 per cent? This question was faced within the last year by American Cyanamid Co.'s management at Willow Island, W. Va. The answer was found to be "yes" under these conditions:

1. Continued availability of water, usually in a lake or a river, to recharge the formation from which the water is drawn.

2. Nonimpairment of the transmissibility of this formation.

Where these conditions exist, and through a jet cleaning process, a collector's capacity can be restored at a fraction of the cost of installing a new well.

If the transmissibility of the aquifer (earth area) is less than at the time of installation, it cannot be expected that the well will regain its original capacity. A method devised to determine the transmissibility of the formation, or its specific capacity, will be discussed later. However, even if the transmissibility has declined, it is possible that cleaning of the collector's lateral screen pipes will increase the capacity at a per-gallon cost much lower than that of building a new well.

American Cyanamid's plant at Willow Island is located on the east bank of the Chio River. The plant obtains its water from three radial-collectors. Two are on the east bank of the river, where they were built in 1947-48. A third, installed in 1952, is centrally located on Lower Brothers Island approximately one mile upriver from the plant site.

Radial-collectors are built by sinking a reinforced concrete caisson, and from the bottom of the caisson projecting lateral screen pipes horizontally like the spokes of a wheel. Water is pumped from the caisson.

Two of the radial-collectors at Willow Island were built with seven laterals totaling 1000 feet; the third with nine laterals, also totaling 1000 feet. These lateral pipes are perforated with slots at the rate of 144 every foot. Slots are ⅜-inch by 1¼ inches.

Each lateral has a ten-inch valve at the entrance to the caisson, which is 13 feet in diameter and 81 feet 11 inches from top to bottom. Hardpan elevation of the caissons is 560 feet, 26 feet below the pool elevation of the Ohio River.

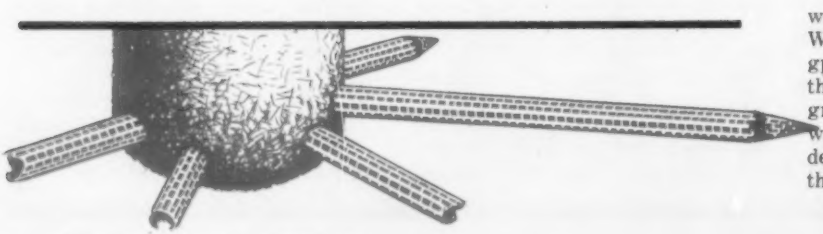
The initial capacities of the three wells were, in order of construction: Well A, 2770 gpm; Well B, 1200 gpm; Well C, 3000 gpm. Although these capacities total 6970 gpm, the greatest ever realized at one time was 6120. This was because of the decline in Wells A and B before the construction of Well C.

In October 1959, after the total

SPECIFIC CAPACITY (GPM/FEET OF DRAWDOWN)

	RIVER TO WELL		RIVER TO TEST-HOLE*		TEST-HOLE* TO WELL	
	Initial	Present	Initial	Present	Initial	Present
A	127	72	138	96	1390	297
B	57	39	98	59	140	114
C	136	84	151	165	1320	171

*40 feet from caisson



capacity of these three wells had declined to 4300 gpm, a study was undertaken to evaluate the well water requirements of the Willow Island plant and determine the best methods of obtaining adequate water for future needs.

At that time the three wells were being pumped to the maximum drawdown. Experience with wells in the Ohio River area indicated that the pressure drop in the aquifer and well laterals under such conditions rapidly accelerates the deposition of solids and otherwise decreases the specific capacity to the aquifer so that the well capacity declines.

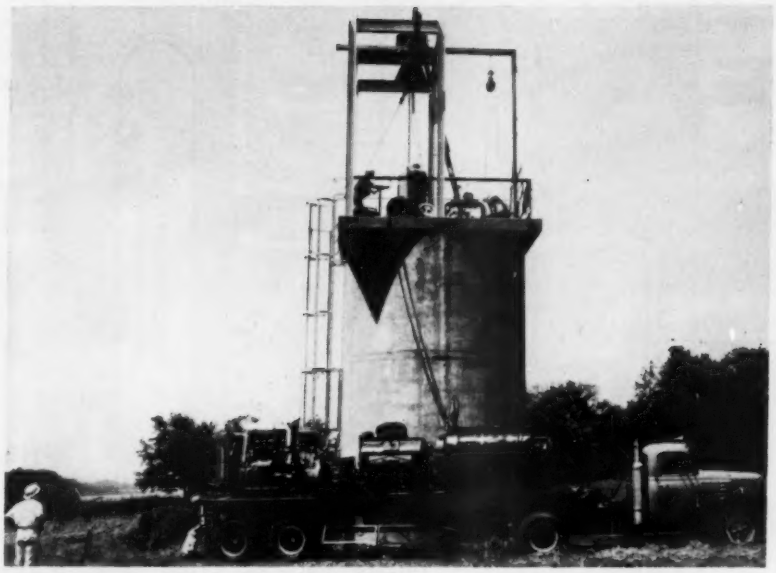
The study produced these conclusions:

1. The well water supply was inadequate for continued plant operation at production levels encountered in 1959.
2. Because the rate of decline in the capacity of the collectors had not leveled off, further decline in the capacity of the collectors was expected.
3. Ability of the plant to expand production was dependent on obtaining additional capacity.
4. The existing well water supply was being utilized to nearly the fullest extent.
5. Because of the need for low-temperature (65 F) water, it was not possible to reduce the well water demand appreciably by converting to cooling tower water, river water, and so on.

At that time it seemed there was no choice other than drilling new wells or installing a new radial-collector. The only drilled well at the plant site had been built in 1946 to furnish water for plant construction. This well, providing 100 gpm, was returned to service in 1959 when a shortage was foreseen.

It was estimated that the capacity could be increased by 250 gpm for each drilled well, or by 3000 gpm for a new radial-collector. Cost figures of a general nature indicated the capital investment on a gpm basis would be at least $60.

Consideration had been given the possibility of cleaning a radial-collector by filling the caisson with acid and letting the acid flow out through the laterals. But it was realized that the acid would flow only along the line of least resistance, or outward through the slots that were not plugged, rather than force itself through the sand and other solids in the blocked pipes.



Dow specialized well-cleaning equipment includes twin diesel engines that develop 308 hydraulic hp for water force of 2500 psi

American Cyanamid had previously engaged Dow Industrial Service for the cleaning of equipment within the plant. However, it was not until after we had completed our study that we learned Dow had developed techniques for cleaning radial-collectors. Faced with a water shortage last winter, we called upon Dow Industrial Service to jet-clean the laterals in one of our wells.

Well A was selected because of its nearby location and because its capacity had experienced the greatest decline (from 2770 gpm to 1500 in January 1960). Also, the calculations indicated that a five-fold decrease in specific capacity had been suffered in the vicinity of the well laterals. (*Specific capacity* as used here is the well maximum continuous pumping rate in gpm divided by the difference in water level in the test-hole and in the well caisson.)

Carried out over a 40-hour period on a round-the-clock basis in subfreezing cold, the Dow Industrial Service cleaning boosted the capacity of Well A to 2100 gpm, an improvement of 600 gpm. Twenty tons of sand were pumped from the well.

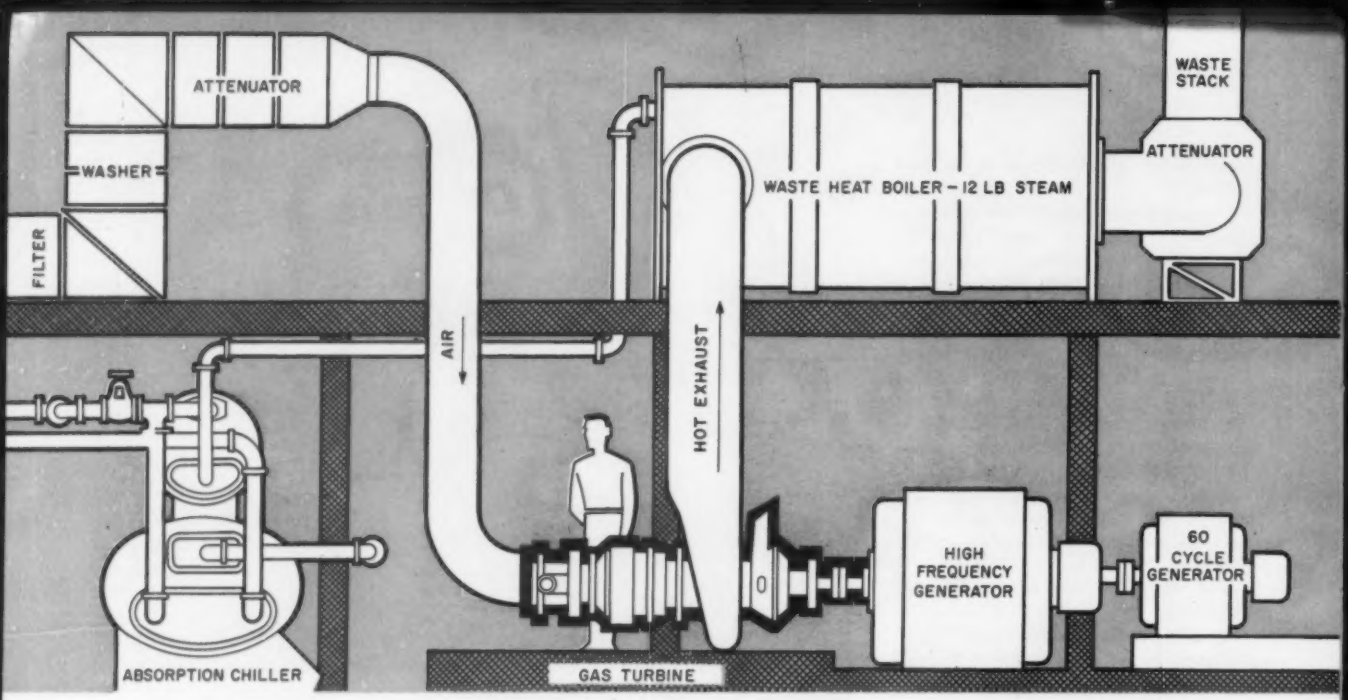
This added capacity was obtained at a gpm cost of $18. Including the cost of overhauling the pump that had removed the sand, our total expense was $11,000.

CLEANING WELL C. With the water shortage alleviated and our approach to the problem verified by the results from the Well A cleaning, a decision was made to proceed with a similar cleaning job on Well C. Cleaning of Well C by the Dow Industrial Service during the 1960 plant-wide shutdown resulted in an increase in the capacity of this well from 1900 gpm to 2750 gpm.

Although this job involved transporting equipment by barge to and from Lower Brothers Island, it was accomplished at a cost of $10,000—again requiring a pump overhaul to keep the sand moving out of the caisson and into the river. Of course the greater step-up in capacity reduced the gpm cost even more, cutting it to $12.

In determining the transmissibility of the aquifer, we established a guide from the calculations shown in the table shown on the opposite page (see above for definition of specific capacity). River-to-well figures are proportionate to the capacity decline in each well. River-to-test-hole figures show gpm pumped from the well per feet of drawdown from river level to test-hole water level. Test-hole-to-well figures show gpm pumped from well per feet of drawdown from test-hole water level to the well caisson water level.

The crucial figures in estimating the gain that can be expected from cleaning are those for the test-hole to well. These tell the status of the aquifer and well laterals in the immediate vicinity of the well. However, other factors involving transmissibility, recharge, etc., must be taken into account. END



PACKAGED ENERGY AT 70 PER CENT EFFICIENCY

Gas turbine packaged to supply heat and power for industrial and commercial buildings and schools

NATURAL GAS may take an increasing share of the electric utility market if the current drive by the gas industry is successful. In addition to developing new markets, gas companies are concerned about the loss of heating load in large buildings due to the use of high intensity lighting and electric heat. High lighting levels in some buildings in the South have obviated the need for any space-heating facilities.

Basis of the new drive is a packaged utility plant, designed around a gas turbine. Such a plant could supply all of the building's utility needs, except water, at an over-all efficiency of up to 70 per cent.

Some success has already been achieved in this campaign. Park Plaza shopping center in Little Rock is believed to be the nation's first privately owned all-purpose utility plant powered by the gas turbine.

As part of the new educational drive, American Gas Association and Southern Gas Association commissioned the Houston firm of Golemon and Rolfe to prepare a research study on schools. This study is described in a brochure entitled A New Look At New Schools.

This study envisions a compact school design, freed of the age-old concepts that placed heavy emphasis on natural means of ventilation and lighting. The compact design can make better use of the site, is independent of orientation, and provides a better plan simpler to administer.

Such a design has received much attention recently. Particularly liked is the fact that it can be built for up to 20 per cent saving in first cost. Its one disadvantage was its cost of operation, which was higher than that of a conventional school.

WHAT WAS LEARNED. Golemon and Rolfe were commissioned to design a mechanical and electrical system which, when incorporated in the compact school, would allow it to operate for less money than the conventional school.

Preferred solution uses a single-shaft gas turbine driving two generators. The high-frequency generator provides lighting power, while the 60-cycle generator supplies motors and convenience outlets. Exhaust heat goes to a waste heat boiler which supplies steam for heating and for an absorption chiller. Schematic drawing above illustrates this.

This system is estimated to save about 16 per cent of what it would cost to operate a similar school using purchased power, or about 7 per cent of what it would cost to operate a conventional school that did not have air conditioning.

These figures are impressive in promising much more for the school dollar, and the natural gas industry is working hard at making them known. Of particular interest is the fact that gas turbine packages, in the sizes that would be used for these applications, are readily available and comparatively low priced because of large production.

Northern Illinois Gas Company announced at its recent stockholders' meeting that the new system will be used in the company's new general office building near Aurora and in a divisional unit building in Glen Ellyn. Operating and cost data obtained from these plants will be extremely valuable in the forthcoming sales campaigns. END

Power plant stretches diesel service -cuts maintenance costs- with

By C. F. KLENNER **Carl Klenner is a specialist at helping customers with their lubrication problems. A graduate of the Michigan College of Mining and Technology, he has been serving commercial customers since 1948. He also attended the Company's Sales Engineering School.**

★ ★ ★

At Roseau, Minnesota, the Municipal Power Plant uses Fairbanks Morse Diesel Engines for the generation of the city's electricity. And since 1946, lubricating oils supplied by our Company have played an important part in the excellent maintenance of this plant.

For example, diesel unit number two was overhauled in 1954 after six years' service. At our recommendation, AMERICAN D&G Oil No. 53 was put in the crankcase at that time. After 19,000 hours of oil service, the unit was taken down again. All rings were free, bearings and rings showed minimum wear, and there was negligible carbon on the piston skirts. With AMERICAN D&G Oil, this unit has averaged 4,584 horsepower-hours per gallon of oil.

For additional information about AMERICAN D&G Oil, contact your nearby American Oil Office.

American's C. F. Klenner checks performance reports with power plant superintendent Carl Grand.

Quick facts about
AMERICAN D&G Oil

- **Made from highest quality solvent-refined stock.**
- **Contains additives which impart superior detergent-dispersant and anti-corrosion properties.**
- **Anti-foaming.**
- **Oxidation resistant.**
- **Recommended for**
  —use with economy fuels.
  —extreme load service.
  —low temperature service.

AMERICAN OIL COMPANY
910 S. Michigan Ave., Chicago 80, Ill.

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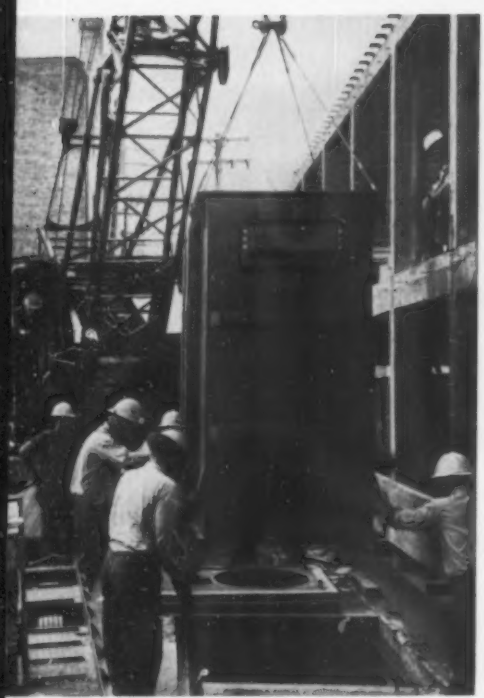
AMERICAN® D&G Oil No. 53

UTILITY INSTALLS FIRST SPECIAL GAS FILLED NETWORK TRANSFORMER

W. M. Winslow, Public Service of Colorado, describes smaller, lightweight unit



Underground Transmission Dept. personnel lower first C_3F_8 gas-filled network transformer ever produced into vault at Colorado Public Service's HQ office building. Transformer is 108½ inches long, 95 inches high, and 52 inches deep

FIRST NEW-TYPE NETWORK transformer, filled with perfluoropropane (C_3F_8) gas, has been installed by Public Service Co. of Colorado. This unit is in the company's new headquarters building in Denver.

In addition to the gas-filled transformer, two conventional askarel-filled transformers, all manufactured by General Electric Co., will be used in the new building, scheduled to be occupied in February 1962. Each transformer is 1500 kva, three-phase, for the 265/460-volt spot network vault service.

Perfluoropropane is the chemical name of one of the least reactive substances known. The gas, 6½ times heavier than air, is maintained at a pressure of 4 to 12 psi gage, depending on temperature and altitude.

This gas-filled unit weighs 59 per cent less than the askarel-filled units. Unlike the liquid-filled transformer, gas can leak out; and, at atmospheric pressure (zero pounds gage) the basic impulse level will have been lowered from 95 to 50 kv, with little change in overload capacity. The sensitivity of halogen gas detectors to perfluoropropane allows the detection of small leaks, even in open air at storage yard locations.

The new unit is versatile, from an installation standpoint; it can be installed indoors or outdoors, in corrosive or hazardous atmospheres, on overhead balconies or in basements. No planned maintenance is necessary on the new unit other than a check to determine proper tank pressures and temperature.

Internally, the unit utilizes glass, terretex, porcelain and exclusive Alpholite (trademark of G.E. Co.) insulation materials. Alpholite is used for cylinders, end rings, duct-spacers and phase-barriers. Terretex is used for high-voltage conductor insulation; glass is used for low-voltage conductor insulation. Porcelain is used for coil and bus support insulators. The insulation structure of the C_3F_8 transformer is basically inorganic, making it a Class "H" structure. Cold-rolled, grain-oriented silicon steel is used for the transformer core.

ENTIRE INTERNAL ASSEMBLY is bonded with cured silicon varnish. This seals the structure against moisture, or dust, before the unit is tanked, or to protect the core-and-coil structure should the tank seal be broken in the field.

High insulating properties of the gas-filled unit have enabled a reduction in its size. This lighter weight means that the unit is more versatile, and easier to install, than the former sealed dry unit, which was lighter than the average industry sealed dry-type unit. By comparison, weight of the new unit is 12,500 lb, as compared with 21,000 lb for the conventional unit.

Benefits of the smaller dimension include less space requirements at the installation site, and less expensive installation, when placed on transformer pads, in rooms or vaults.

Basic impulse insulation level of the 15-kv class, C_3F_8 transformer is 95 kv, as compared with 50 kv for the NEMA standard for sealed dry-type units. END

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109

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new power construction

Fairbanks, Alaska—Chatanika Power Co., Inc., 653 Tenth St., has announced that it has begun work near here on the installation of a 130-ft high earthfill dam on the Chatanika River. A hydroelectric plant with an initial capacity of 15,000 kw will also be installed. Unit is expected to be placed in operation by late 1963, and cost of the entire project reportedly will exceed $8,000,000.

Fontana, Calif.—Southern California Edison Co., 500 West Fifth St., Los Angeles, has authorized plans to install a third generating unit at its Etiwanda Avenue Power Plant located here. When completed late in 1963 the new installation, to have an initial generating capacity of 310,000 kw, will represent an investment of approximately $43,155,000. Bechtel Corp., of San Francisco, has been awarded the engineering and construction contract.

Panama City, Fla.—Gulf Power Co., 75 N. Pare St., Pensacola, Fla., has authorized plans to install a new steam-electric generating station on North Bay, near here. New unit will have an initial capacity of 150,000 kw and will include the installation of high-pressure boilers with auxiliary equipment. Work will begin at once and is scheduled to be completed late in 1963. Cost reportedly will exceed $20,000,000.

Chicago, Ill.—Northern Illinois Gas Co., a natural-gas utility, is considering plans to produce electricity for two of its office buildings, using natural gas as fuel. A divisional office in Glen Ellyn, Ill., is now under construction, and the company plans to begin another building project this fall near Aurora, which will be used as general office headquarters. Northern Illinois plans to use a new power system for heating, cooling, lighting, and other requirements. Natural gas will be burned to power a series of turbines which will drive generators to produce high-frequency electrical current. If experiments are successful, company sees a promising gas market in this direction.

Great Bend, Kans.—Community Hospital Associates, Inc., this city, has announced plans to construct a multistory reinforced concrete and steel, air-conditioned medical center building at a total construction cost of $2,800,000. A 40 by 120-ft boiler and maintenance building will be erected to house high-pressure steam boilers. Work will begin at once and should be completed late in the fourth quarter of 1962.

Owensboro, Ky.—City Utility Commission, 412 Frederica St., has author-

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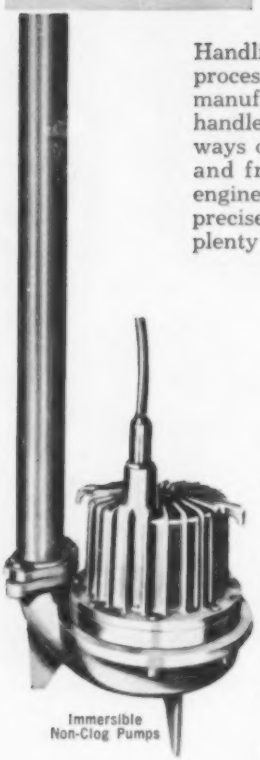

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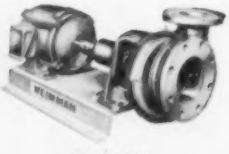

Single Stage, End Suction Pumps

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ized plans and will start construction at once on a two-story municipal electric power plant, on a large site recently selected two miles east of this town. Plant will be equipped with a steam-electric generator with an initial capacity of 125,000 kw, high-pressure boilers, and other auxiliary equipment. To be completed late in 1963, the plant will cost approximately $25,000,000.

Gaithersburg, Md.—General Services Administration, Regional Office Building, 7 and D Streets, Washington, D.C., has announced contract award of $7,737,987 for the construction of a large laboratory and boiler plant at the National Bureau of Standards Building, located here. Paul Tishman Co., 21 E. 70th St., New York, N.Y., has been awarded the construction contract, and work will begin at once. Project's completion is scheduled for late fall, 1962.

Lebanon, Mo.—Laclede Electric Cooperative, 321 S. Jefferson St., this city, has authorized plans to install a 55-mile electric transmission line involving short service extensions, tie lines, multiphasing of phase lines, and increased transformer and service capacity, including the installation of capacitors and voltage regulators. Work will proceed in a company-served six-county area.

Omaha, Nebr.—Omaha Public Power District, 803 Electric Building, has authorized plans to construct and install a fourth steam-electric generating unit at its North Omaha Sation. When preliminary engineering work is completed, work will begin on the new unit, which will have a capacity of 125,000 kw and will be completed in the spring of 1963.

Trenton, N.J.—Public Service Electric & Gas Co., 80 Park Place, Newark, has announced that the second unit at the new Mercer Generating Station on the Delaware River in Hamilton Township has been placed in commercial operation. The capacity of the new unit (320,000 kw) and the first unit, which was placed in operation late last year, are said by the company to be the largest in the State. Mercer is the fourth new station to be built by Public Service since 1945. Company's system total generating capacity is now 3,827,000 kw.

New York, N.Y.—A tower of light, which should be visible from as far away as Boston and Washington, D.C., is planned as port of the investor-owned electric utility companies' exhibit at the 1964-65 New York World's Fair. V-E-K Associates will design this unique rainbow-colored tower, which will be 80 feet high. Twenty-four "light cannons" will be of one billion candlepower each. Preliminary estimates set the cost at between six and seven million dollars for the entire Power & Light Exhibit project.

New York, N.Y. — General Public Utilities Corp., 61 Broadway, has announced the sale of its lone foreign subsidiary, Manila Electric Co., to a Philippine investment group, Meralco Securities Corp., for approximately $46,000,000 in American currency. Manila Electric Co. supplies electricity to about 350,000 consumers in the area of Manila. It generates about half of its requirements in company owned steam stations and buys the rest from the National Power Corp., an agency of the Philippine government.

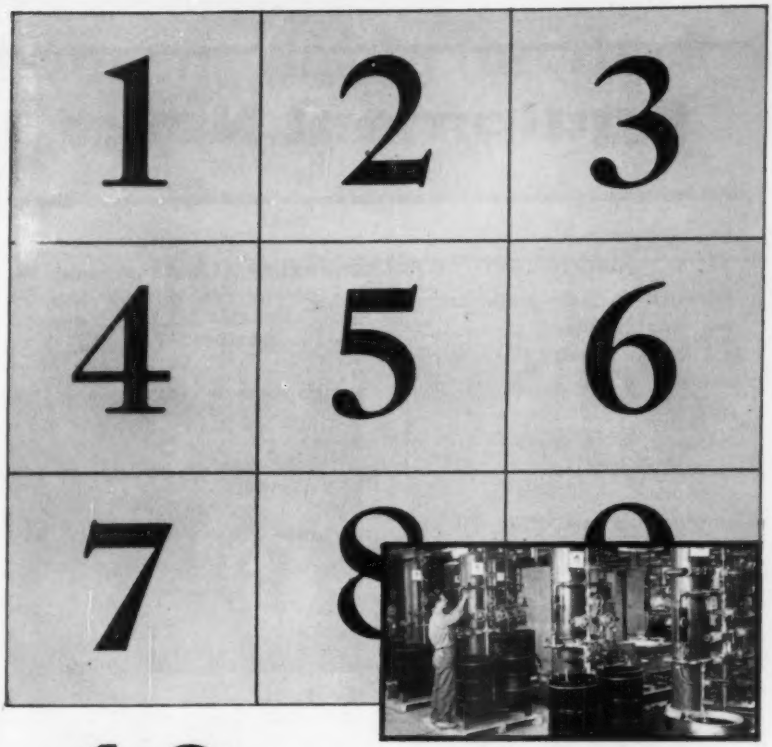
Galion, O.—City Council, City Hall, has arranged financing for $200,000 to construct a new power substation in the Heise Park area in connection with the municipal power plant. Plans also include modernization and improvement to the municipal plant for increased capacity. Work will begin soon.

Goliad, Texas—South Texas Electric Cooperative, Gonzales, Texas, is considering plans to construct a steam-electric plant at this location. A preselected site will cost about $6,750,000. A $250,000-repair shop is also planned. To begin at once, work on the projects is scheduled to be completed by the second quarter of 1963.

Houston, Texas—Board of Trustees of the Methodist Hospital has authorized contract award of $1,510,700 to the Baxter Construction Co., also of this city, for major improvement and expansion of the hospital's power plant and laundry facilities at this location. Work is scheduled for completion by the fourth quarter of 1962.

Victoria, Texas — Central Power & Light Co., 120 N. Chaparral St., Corpus Christi, has authorized plans for a major expansion of its power station facilities at this location. Plans include the installation of a 175,000-kw steam-electric generating unit at a cost of $13,000,000, including high-pressure boilers and auxiliary equipment. Work will begin soon and is scheduled for completion by the summer of 1963.

Genoa, Wis.—Allis-Chalmers Manufacturing Co., of Milwaukee, and Dairyland Power Cooperative, of La Crosse, Wis., have announced plans to construct and operate a demonstration model of a "boiling water" nuclear power plant for the Atomic Energy Commission near this site. Allis-Chalmers will be awarded a fixed contract for about $10,800,000 to design and build the reactor and train personnel. Dairyland Cooperative will provide the site, operate the plant for ten years after its expected completion in 1964, buy the steam produced by the reactor, and provide the steam-driven electrical generating equipment, at an estimated cost of $7,850,000. The plant will have an initial generating capacity of 50,000 kw.



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Model BD Softeners: This complete line of Permutit units takes advantage of standardized mass-produced components and a new design, to radically cut the cost of industrial water softening. Shipped in component kit form for easy assembly and fast installation. Available in these sizes and capacities:

Shell Diam.	Straight Height	Flow Rate Average	Softening Capacity
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48″	6′	100 gpm	1380 kgr

Standard Packaged Demineralizers: Permutit's skid-mounted, mixed-bed units require no field assembly, no delays, no capital tied up in construction. Each is pretested and factory-guaranteed. Just make the plumbing and electrical connections and put the unit to work.

Now available on ten-day delivery are the 12″, 15″, 20″ and 24″ sizes, giving you flow rates up to 20 gpm (50 gpm for polishing). All of them can produce demineralized water averaging over 6,000,000 ohms specific resistance, or about 0.05 ppm dissolved solid content.

A small size mixed-bed demineralizer, model MBD-6A, can also be delivered from stock.

Also available for fast delivery: Other types of demineralizers, and fully packaged water treatment systems providing flow rates up to 50 gpm, can be quickly assembled from Permutit's standardized components and shipped to you on accelerated delivery schedules.

For further details on any of these products, write, wire or call our Permutit Division, Dept. PE-81, 50 West 44th St., New York 36, N. Y. (OXford 7-6600). (In Canada, contact the Permutit Company of Canada, Toronto.)

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Equipment News

Described on these pages are new and improved products. Use Reader Service Cards on pages 91-92 to ask for more information. Just circle item numbers of the products.

1—Improved insulating oil has higher flash point

For large transformers and high output electrical equipment, improved Diala Oil AX is announced by Shell Oil Co. as having minimum flash point specification of 295 F (Cleveland open cup) with typical flash point test valves from 300 to 305 F. This enables safe and continuous operation of equipment at higher outputs and temperatures than before, it is pointed out. Diala Oil AX has been achieved without change in maximum viscosity specification of 60 SSU at 100 F. It is oxidation inhibited and formulated to resist oxidation, sludging and lacquer formation at high operating temperatures. The oil will be available initially east of the Rocky Mountains.

2—Personal radiation monitor is compact, clips to clothing

The ORNL, a personal radiation monitor that gives audible and visual warning, is produced by The Victoreen Instrument Co. About the size of a fountain pen, it can be clipped to the clothing. It gives off high-pitched chirps and light flashes to warn of radiation exposure or sudden shifts in radiation levels. The unit is powered by a small mercury cell which, manufacturer claims, will give about 30 days' uninterrupted operation.

3—Incipient fault detector for power transformer use

Model HM-258 Kit, an inexpensive acetylene gas detector assembly available from Devco Engineering Inc., is

designed to provide a rapid, accurate colorimetric method of detecting acetylene in the gas space of oil-filled transformers and regulators. It is pointed out that acetylene is a product of decomposition of oil and insulation due to arcing under oil, and its presence indicates that a fault has occurred.

4 — Totalizing flow meter is easily installed, accurate

Model 380 Propeloflo Meter, introduced by B-I-F Industries, offers high accuracy in metering water and other liquids, requires no pipes or mercury and totalizes directly. It features high tensile cast iron body with molded plastic propeller designed to withstand and register overloads to 150 per cent. Available in eight sizes, meter is designed to measure flow from 20 to 2400 gpm, with accuracy within ±2 per cent of actual flow over rated operating range, including temporary flow rates to 150 per cent of rated capacity. Bulletin Ref. No. 380.20-2 gives details.

5—Substations of 500-kva capacity, compact size

Package-unit substations, Power-Zones combine compact size and easy handling with capacities from 75 to 500 three-phase kva, primary voltages to 4800 v, secondary voltages to 600 v. A forced-air cooling system with high temperature alarm is available to increase kva capacity by one-third. According to manufacturer, Square D Co., versatile construction permits use of many types of components. Metering equipment, high voltage air interrupter switches, main low voltage power circuit breakers etc. can be furnished as required. Bulletin SD-137 gives details.

6—Dual pressure valve has non-interflow design

Dual pressure, two-stage Lo-Torq Selector Valve, introduced by Republic Mfg. Co., is non-interflow, smaller in size and lighter in weight. Constant seal with non-interflow design prevents fluid-flow between ports when valve is turned. Sliding seals wipe across the rotor, keeping sealing surfaces clean and reducing wear. Handle has 105-deg turn, with four positions. Seals are dynamically loaded—as line pressure increases seals become tighter. Slight area-differential unbalance reduces turning torque at high pressures. Design is standard on ½- to 1½-in. sizes, internal pipe thread, and is suggested for both water and hydraulic services.

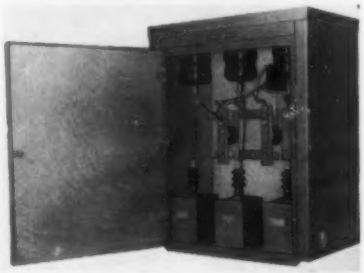
7 — Railroad car vibrator creates heavy impact

The 3-in. KO-LSRR weighs less than 70 lb yet can create a vibratory force of over 1000 lb, according to The Cleveland Vibrator Co. Designed to fit standard railroad hopper car bracket, the portable, air powered vibrator can be lifted from its mounting and moved

without loosening or tightening bolts or other attaching devices. Handle facilitates carrying or removal. Intensity and frequency of vibration are regulated by adjusting air supply to piston. Unit delivers over 1700 vibrations per minute at 60 psig, will operate on as little as 30 psig pressure.

8—Line surge protection unit for rotating a-c machines

Custom designed for each application. Surgepaks protect rotating a-c machines against line surges caused by



switching, faults, or lightning. Products of Westinghouse Electric Corp., they are attached and wired into the ma-

What Really Happens Inside the Bucket

Exploding a widespread misconception of the operation of inverted bucket steam traps

In describing the operation of the inverted bucket trap many well meaning people—and some not so well meaning; i.e., competitors—refer to the need for a "bucket full of steam" to close the trap, and a "bucket full of condensate" to open the trap. The implications of these requirements are many. Sometimes they are contradictory. Often they are misleading. Observations of a trap with a glass body and a glass bucket plus trap design considerations tell the true story.

* * *

In a well designed inverted bucket trap (Armstrong, naturally) the bucket will float and close the valve when it is *no more than two-thirds full of steam.* For example, the bucket in an Armstrong No. 812 trap is $3^{15}/_{16}$" deep. It will float with only 2" of steam.

Good design also dictates that the maximum test opening pressure of a trap should be well in excess of the maximum working pressure for which the trap is furnished. For example a No. 812 trap for 100 psi with the bucket filled with cold water should open at a test pressure of at least 165 psi. Therefore, the bucket does not have to fill completely with condensate to open at 100 psi. The entrance of 1.20" of condensate will cause the bucket to sink. .8" of steam remains at the top of the bucket at the time it is heavy enough to open the valve at 100 psig and with no back pressure.

Thus the opening and closing of a 100 psi trap with $3^{15}/_{16}$" deep bucket is controlled by a change in the water level of only 1.20".

In actual practice the 100 psi trap may be draining a steam main in which daytime pressure is only 30 psig. Instead of requiring a 1.20" rise in bucket water level to open the trap against this pressure, the bucket will be heavy enough to open the valve as soon as the water level in the bucket has risen about $^3/_{16}$".

Obviously, it does not "take a bucket full of steam" to close the inverted bucket trap, or a "bucket full of condensate" to open the trap.

What's the Significance?

As illustrated above the opening of an Armstrong Trap requires the accumulation in the trap of less than one-third of a bucket full of condensate. This assures good operating characteristics for the vast majority of services by discharging small accumulations of condensate as soon as they reach the trap. It also assures frequent opening pressure drops to break up air and condensate films on heat transfer surfaces and thereby maintain high heat transfer rates in the unit being drained.

Additionally, the fact that no more than two-thirds of a bucket of steam is required to float the bucket means that there will always be a generous water seal at the bottom of the bucket. In the case of the No. 812 trap described above, it will be 1.8" deep. This insures that no steam can leak from the bottom of the bucket. More importantly, the bucket can float to close the valve even when the bucket is not completely submerged in condensate.

A Proven Principle Engineered Up to the Minute

While the inverted bucket concept for steam traps is half a century old, today's Armstrong inverted bucket traps incorporate design considerations unknown 50 years ago. The inverted bucket of the Armstrong trap, for example, is not just an upside down bucket. It is a carefully sized, weighted and vented component of a steam trap mechanism that experience proves will do its job right. Throughout, Armstrong design has kept pace with technological advancements, modified when necessary to meet changing requirements.

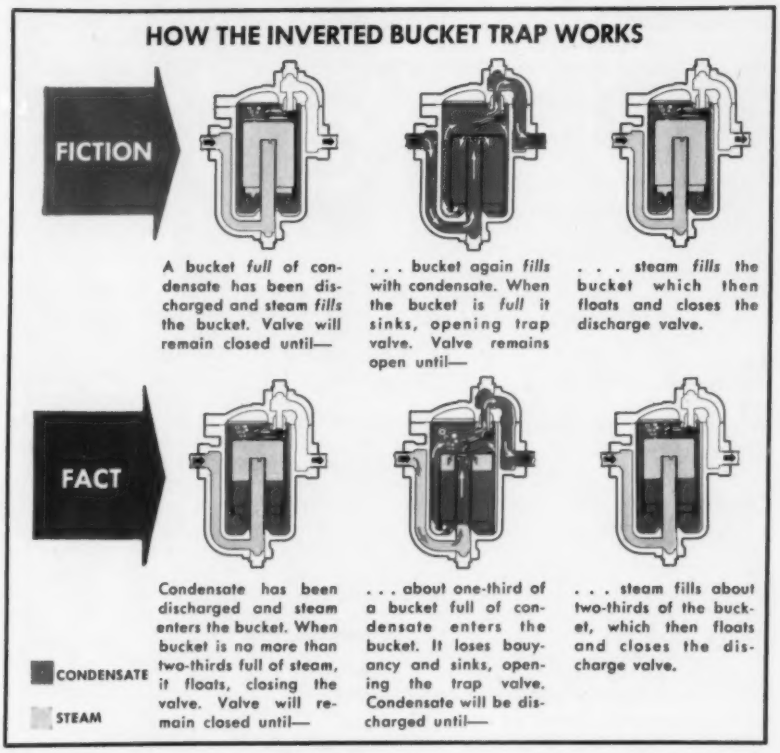
We do not claim that Armstrong Traps will do every single job better than any other trap. But we do believe it will do more jobs better and more consistently than any other trap. More important, though, for most services, Armstrong Inverted Bucket Steam Traps enable you to get more efficient steam utilization with minimum problems.

We're so sure of what Armstrong Traps can do that we unconditionally guarantee that they will satisfy you. You are the sole judge, too, so there's practically no risk.

* * *

The 48 page Armstrong Steam Trap Book describes other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write: **Armstrong Machine Works, 8105 Maple Street, Three Rivers, Michigan.**

ARMSTRONG STEAM TRAPS


HOW THE INVERTED BUCKET TRAP WORKS
FICTION
A bucket full of condensate has been discharged and steam fills the bucket. Valve will remain closed until—
. . . bucket again fills with condensate. When the bucket is full it sinks, opening trap valve. Valve remains open until—
. . . steam fills the bucket which then floats and closes the discharge valve.
FACT
Condensate has been discharged and steam enters the bucket. When bucket is no more than two-thirds full of steam, it floats, closing the valve. Valve will remain closed until—
. . . about one-third of a bucket full of condensate enters the bucket. It loses bouyancy and sinks, opening the trap valve. Condensate will be discharged until—
. . . steam fills about two-thirds of the bucket, which then floats and closes the discharge valve.
CONDENSATE
STEAM

For more data circle 535 on Post Card

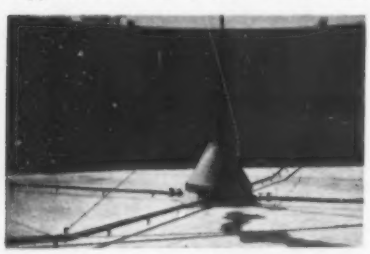
chine's circuit by either manufacturer or user. Ratings are available for system voltages from 2400 to 13,800 v. The device is equipped for a three-phase installation, one lightning arrester and one capacitor tied in parallel to ground on each phase, with isolated buses and common ground connection. Basic components consist of lightning arresters with low discharge and sparkover characteristics in ratings from 3 to 15 kv; and surge capacitors to eliminate possibility of turn-to-turn flashover by decreasing the slope of wave fronts impinging on windings.

9—Record cards forecast failures of motors, generators

Associated Research, Inc., offers a system for predicting failures of electrical equipment based on use of insulation resistance record card. By measuring insulation resistance of the equipment at regular intervals and entering the readings on this card, a curve of insulation deterioration is secured. A sudden drop in the curve gives advance warning of insulation failure. A sample Vibrotest Record Card is offered.

10—Clarifier is economical, solids-contact type

Type M Precipitator is described by The Permutit Co., as a sludge blanket type in which jets of water from the tips of the agitator provide the sole driving power required for the agitator unit. This design eliminates the electric motors, catwalks and bracing, commonly required. The agitator rotates on a stub spindle—needs no overhead support. Pre-mixed, raw water and



chemicals are introduced through an inlet at the center of the tank. A conical deflector on the hub directs the water-chemical mixture outward across the tank bottom. Reaching the wall, the mixture tends to rise but is redirected back to the center by a horizontal baffle on wall. In this way, a rolling current pattern is established.

Water chemicals and sludge are kept in intimate mixture. An effective sludge blanket is maintained in suspension. Sludge and heavy particles settle to the bottom; clarified water is drawn off the top. In addition to simplification of agitator installation, the design of the agitator arm, which includes supplementary jets, reduces the baffling within tank, contributing to cost reduction. Permutit Co. plans to build units with rates from 150 to 7000 gpm.

11 — Closer-mesh floor grating designed for greater strength

This steel grating, introduced by Blaw-Knox Co., retains vital factors of open flooring — visibility, ventilation and easy maintenance. Load bearing capacity has been increased 60 per cent through the use of 36 bars in each 2-ft width with clear opening of ½ in. (grating is also available in 37 bars in each 2-ft width with ⅜ in. clear opening and in other bar sizes). It is sugested for utility applications and industrial venting uses. The grating is fabricated through an electro-forging process providing one-piece construction of the bearing bars and cross bars which are twisted to provide a rough non-slip surface. Available in lengths of 20-ft or more, grating may be obtained galvanized, painted or finished with Ponbake, an epon paint process providing a wear-resistant finish.

12—Photoelectric street light control with three components

Model 6620, photoelectric street light control with a simplified circuit, is announced by Fisher-Pierce Div., Sigma Instruments, Inc. A refinement of manufacturer's tubeless Model 6600A, using the same hermetically sealed cadmium sulfide photocell and lightning protection, it also includes an a-c relay to permit elimination of rectifier and capacitors. This control conforms to EEI-NEMA specifications and may be used with numerous luminaires. Models are available for mounting on bases up to 3¾-in. diam. Adapters are available for crossarm, pole top or bracket mounting arrangements.

13—Switchboard features taut-band suspension

The K-221, a low-priced switchboard featuring taut-band suspension, is offered by Westinghouse Electric Corp. It uses no pivots or bearings and is free of friction, so maintenance is virtually eliminated, manufacturer points out, and it protects against severe vibration and shock without loss of accuracy. The K-221 has a basic flange size of 4½-in. sq., a 4-in. scale length and a scale arc of 100 deg. Available in usual ratings of switchboard instruments, it includes a-c and d-c ammeters, voltmeters, wattmeters, varmeters and frequency meters. D-c instruments are core-magnet constructed and shielded from external magnetic fields.

14—Welded seals prevent corrosion of pressure instruments

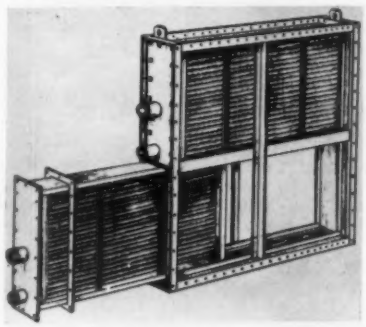
Mansfield & Green, Inc., introduces a welded diaphragm seal designed to prevent corrosion or clogging of pressure instruments by eliminating leakage. The thin metal diaphragm is welded to the thicker top flange. The machined shape reduces the internal volume for a minimum of temperature error and is a back-stop in case of instrument leakage, manufacturer states, and the diaphragm cannot be distorted or blown out. Seals, in a variety of designs and materials, are clean-out type.

15—Boring bit and "chip ejector" combination

This device introduced by Price & Rutzebeck incorporates a "chip ejector" attachment with Plantor JL series bits to eliminate problem of chip clogging in deep hole boring work on poles and timber structures. Photo shows chip ejector—a steel spring with an attaching collar, and 12-in. portable bit. Ejector can be field-added to all JL types. List price for ejector is under $2. Folder P-82 gives details.

16—Air combustion heaters in packaged assemblies

Designed for installation in ductwork breechings, these air combustion heaters by Buffalo Forge Co. feature removable core coils and Aerofin tubing. They come in packaged assemblies, ready for mounting ahead of or behind



forced air fans. Rigid structural steel casings and tube supports prevent coil deflection, and guide angles speed insertion or removal of coils. Coils are pitched in casing for horizontal or

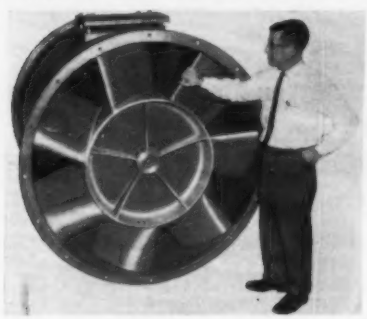
vertical air flow, to provide proper condensate drainage and prevent freezing. Coil tubes withstand temperatures to 700 F. Steam heating coils are available with ⅝ or 1-in. OD copper tubing, and hot water coils come in same sizes. Cupro nickel tubes are also available. Bulletin FD 800 gives details.

17—Impact wrench bits bore holes and tighten nuts

No. 159-W Impact Wrench Bits, introduced by Greenlee Tool Co., enable utility linemen working on poles to use impact wrenches for hole-boring as well as nut-tightening operations. The single-twist bits feature a heavy hex shank 1⅝-in. long, that fits any standard ⅝-in. impact wrench adapter. Deep retaining recess in the shank snap-locks the bit into the quick-change chuck on impact wrench. Bits are available for boring holes from ⅜- to 17/16-in. diam, and up to 18 in. deep.

18—Belt-driven vaneaxial blower available in 60-in. size

This 60-in. diam. belt-driven vaneaxial blower of Hartzell Propeller Fan Co.,



will move 96,450 cfm at 2-in. static pressure or 66,500 cfm at 7-in. static pressure. It has cast aluminum-alloy impellers and all-welded construction.

19—Rubber expansion joint designed to stand high pressure

The AMR (anti-migration rubber) Expansion Joint, made by United States Rubber Co., is said to provide the flexibility of standard joints plus 60 per cent more capacity for withstanding high working pressures, due to its inner construction of metal reinforced rings that remain stable under pressure. This joint can handle corrosive materials and withstand a wide range of temperatures and flow surges. It is available in a variety of constructions.

20—Selenium chargers for all types of storage batteries

These selenium-type chargers of Westinghouse Electric Corp. are designed for cyclic, floating and trickle charging of storage batteries for switchgear control, signals and communications, and engine starting. Each charger

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good designs made better with aluminum

Aluminum cooling system at Oak Ridge includes Tube-Turn fittings

At Oak Ridge National Laboratory, a cooling system utilizing aluminum forces more than 12,000 gal of water per minute through the research reactor. Welding fittings up to 24 in., thought to be the world's largest of aluminum, were made with Alcoa® Aluminum by Tube Turns Division of Chemetron Corporation, Louisville, Ky. Aluminum was selected to maintain purity of the demineralized water. Other advantages: aluminum's low cost, corrosion resistance and superior heat-transfer ability. To take advantage of Alcoa's 35 years of heat exchanger experience, please send the coupon.

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- ☐ 34-11566 *Alcoa Aluminum Heat Exchangers and Condensers*

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The best name we can think of is

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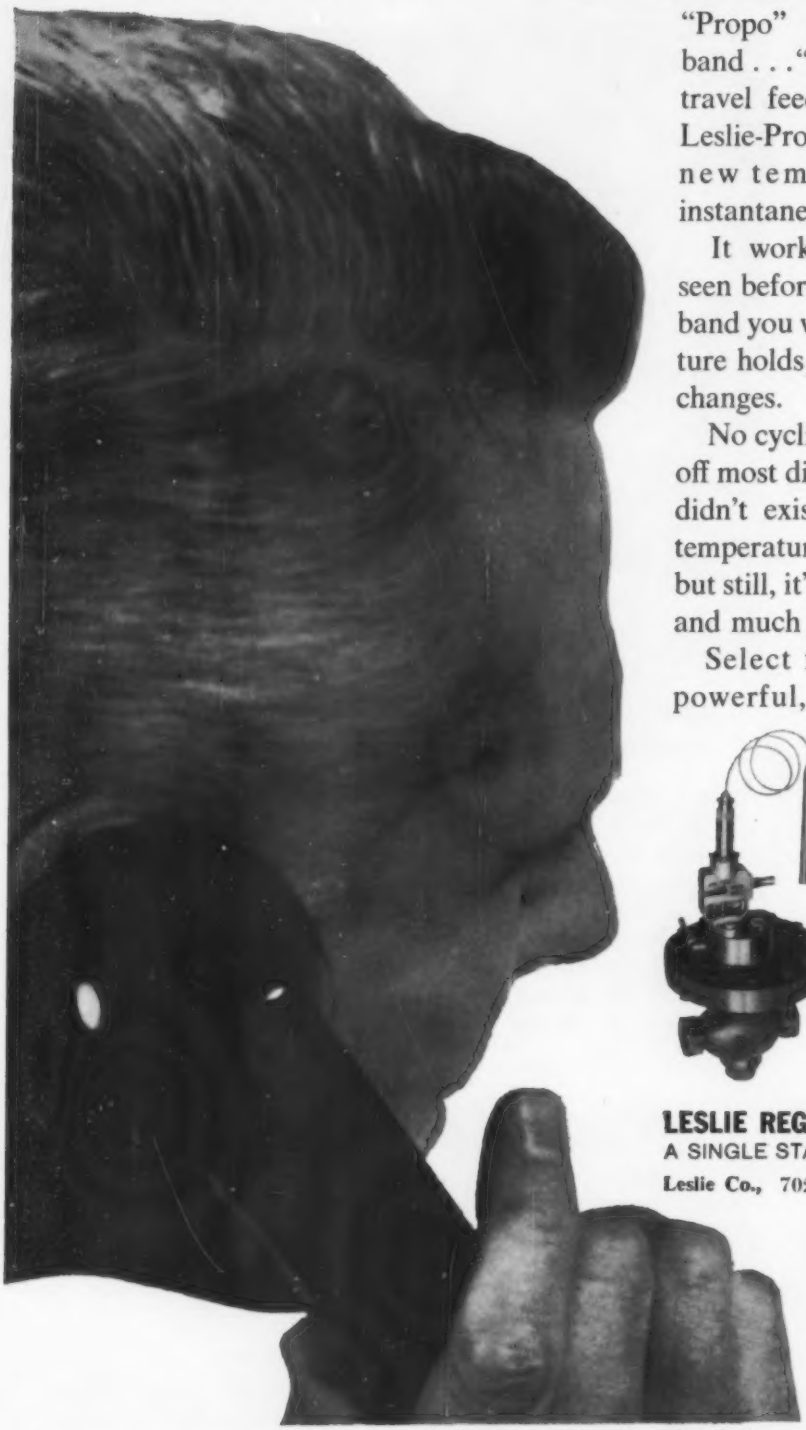

"Propo" for adjustable proportional band . . . "Matic" for automatic valve travel feedback. Put them together — Leslie-PropoMatic® — and you get the new temperature regulator for instantaneous-type heater service.

It works like nothing you've ever seen before. Set the dial for the control band you want, and that's all. Temperature holds steady, even under fast load changes.

No cycling. It's stable! And it shrugs off most dirty steam problems as if they didn't exist. In *effect* it's a pressure-temperature cascaded *control system* — but still, it's a *regulator* — easy to install, and much less in initial cost!

Select from 50F, 100F or 200F powerful, interchangeable thermo elements. Bronze or iron, ½ to 4″, screwed or flanged ends. PropoMatics handle inlet pressures to 150 psi, temperatures as high as 500F.

Engineering Data Bulletin 611 has all the data on PropoMatics. Send for it — no obligation.

LESLIE REGULATORS AND CONTROLLERS

A SINGLE STANDARD OF QUALITY SINCE 1900

Leslie Co., 702 Grant Ave., Lyndhurst, New Jersey

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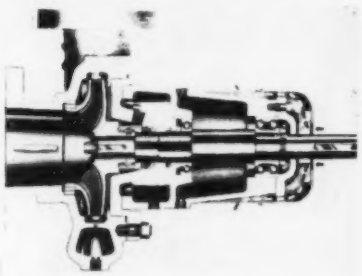
covers a range of battery sizes and sufficient taps and rheostats are provided to allow fine adjustment of charging rate on most applications. Chargers are suitable for resistive and inductive loads. They will charge lead-acid, nickel-alkaline, nickel cadmium batteries. A wide range of cell combinations is available. Steel cabinets have screened openings to allow ample air flow for cooling the selenium stack and transformer. Cabinets are designed for wall mounting; the larger sizes can be shelf or floor mounted.

21 — Process pumps feature parts interchangeability

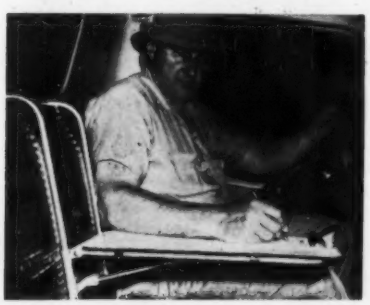
From two basic pump types, the SMJ and SMJI offered by Byron Jackson Pumps, Inc., up to 72 basic combinations are possible because of the interchangeability feature. By interchang-



ing impellers, covers, nozzle arrangements, bearing construction, cooling methods and other components, requirements for almost any service can be met from standard, off-the-shelf parts. Air-cooled bearing housing eliminates need for cooling water supply to bearings in many applications. Model SMJ is for high temperature service with top or end suction; Model SMJI, for lower temperatures.

22—Fold-up writing surface fits on car or truck seat

Introduced by Mishek Supply Co., the Car Desk makes it easy for linemen to handle their paper work. It fits over the seat back, adjusts vertically or horizontally without tools, and folds up when not in use. It can also be used out of the vehicle—the top lifts off. Writing surface is 12-by-20 in. and strong enough to hold a typewriter. The Car Desk will be made available in Masonite at an anticipated cost of



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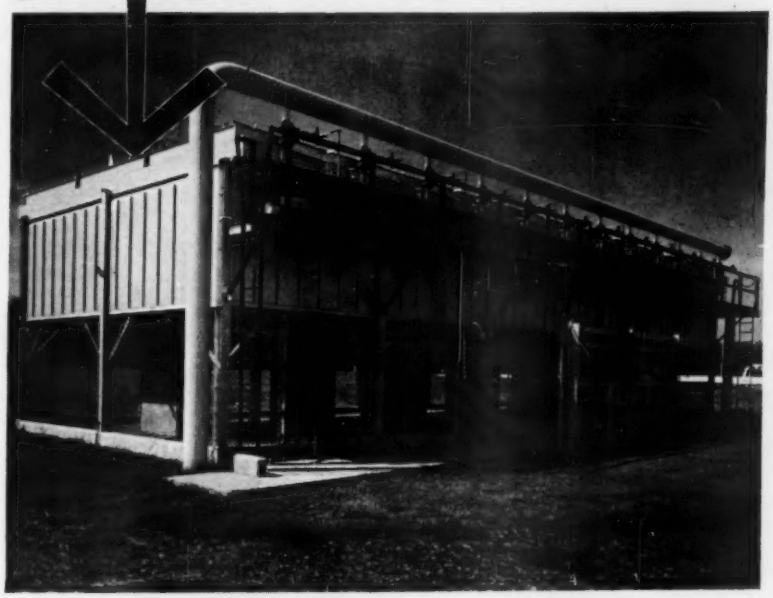

Griscom-Russell heat exchanger has aluminum fins for improved gas engine cooling system

This fin-fan heat exchanger cools gas engine jacket water at the Paris, Tenn., plant of American Louisiana Pipeline Co. Similar units are installed at the Shelbyville, Ind., and Greenville, Miss., plants, all designed and built by Griscom-Russell Co., Massillon, Ohio. Cooling fins, of special G-R design, are made of Alcoa® Aluminum. High thermal conductivity combined with natural resistance to corrosion, ease of fabrication and low first cost made aluminum the logical choice of material. Perhaps Alcoa Aluminum can improve your good design. For more information, please send the coupon.

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- ☐ 42-20849 *Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*
- ☐ 61-21088 *Aluminum Cooling Towers and Their Treatment*

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Any way you look at it, Powell Valve performance really pays off—performance that's conclusively proven in power plants everywhere.

You can find at Powell any type of valve you may need to handle water, oil, gas, air, steam, corrosive fluids, even molten metals and other radioactive materials used in atomic power plants.

Consequently, Powell can help simplify flow control projects and contribute real savings in time and money. For example, in describing a modern 125,000-KW steam-electric generating plant, a leading authority recently listed some 80 areas requiring a total of over 1300 valves . . . Powell could have supplied almost every one.

Learn how this Powell performance can mean a real payoff for you. Contact your nearby Powell Valve distributor, or write direct.

300-pound Steel Globe Valve with welding ends. Outside screw rising stem and yoke. Bolted flanged bonnet. Screwed-in seat ring. Sizes, 1" through 12". Screwed or flanged end valves are available.

600-pound Steel Swing Check Valve with welding ends. Bolted flanged cap. Disc hung on a 5° angle allows full flow through when wide open. Screwed-in seat ring. Sizes, ½" through 8". Can be furnished with flanged or screwed ends.

150-pound Steel Gate Valve with welding ends. Outside screw rising stem and yoke. Bolted flanged bonnet. Solid wedge disc, screwed-in seat rings. Sizes, ¼" through 30". Can be supplied with screwed or flanged ends.

115th year of manufacturing industrial valves for the free world

POWELL STEEL VALVES

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

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around $15.00, or in plastic, around $18.00. (A clip is an optional extra.) Manufacturer states, however, that lower introductory prices will be offered for both models.

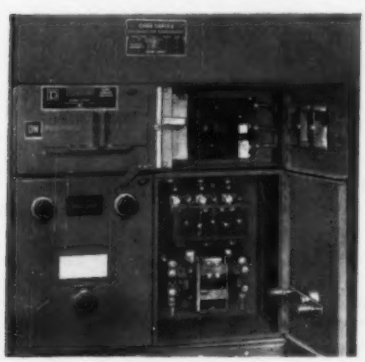
23—Transistorized level control offers flexibility of use

Heart of the Transi-Level Control System is an electronic medium frequency control module combining a static transistorized circuit mounted on a printed circuit board. The complete control module is housed in a cast aluminum assembly—no coax cables required. The relay control unit (left in photo) can be mounted any distance from probe head, such as the normal duty probe

one shown. According to manufacturer, The Emerson Electric Mfg. Co., the Transi-Level can be equipped with a variety of probe heads . . . ceramic angle probes for use with powdered materials, heavy-duty ones for use with coal or gravel, extension-type probes for detecting level of power plant flyash build-up etc. Transi-Levels are available for single-phase operation on 115 or 230 v, 50/60 cycles. Twelve- and 24-v battery units are also available. Only simple low-voltage two-wire leads are required to connect probe units and relay control units. Publication E-26-115 gives data.

24 — Panelboards with circuit breakers, switches, starters

Circuit breakers, fusible switches and motor starters can be mounted in Square D Co.'s QMB panelboards. The circuit breakers (in single and twin units rated from 125-255 and 15-100 amp) and switch units feature plug-in construction, and can be installed or rearranged in minutes. Each unit has an individual steel enclosure with dead-front construction having plug-in units (switches, circuit breakers) mounted above starter, permitting interlocking



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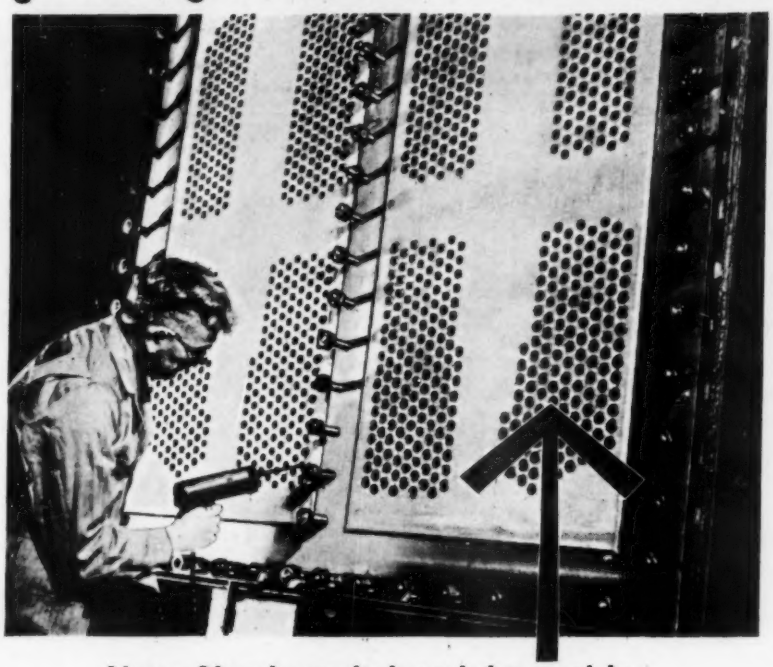

Alcoa Aluminum halves tube cost in Allis-Chalmers surface condenser for experimental nuclear power plant

Shown under construction at Allis-Chalmers Mfg. Co., West Allis, Wisconsin, this 5,300-sq-ft surface condenser is installed in an experimental nuclear power plant at Argonne National Laboratory, Argonne, Ill. Tubing is Alcoa® Aluminum, selected primarily for maintaining low level radioactivity in the reactor circuit by eliminating copper bearing alloys. It has superior corrosion resistance and thermal conductivity, ease of fabrication and economy. Initial savings were significant. Aluminum tubing costs one-third less than mild steel (common sizes), one-half as much as admiralty brass, one-fifth as much as stainless. For more information about other aluminum applications in power stations, please send coupon.

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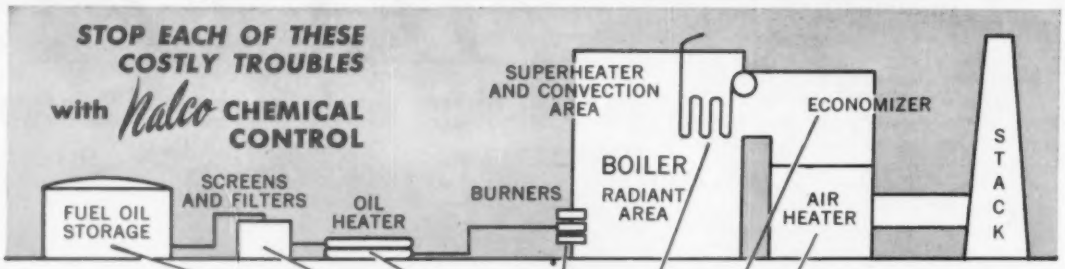
Nalco Residual Fuel Oil Treatments Protect Boiler Systems from Storage to Stack



COMBUSTION PROBLEM	STORAGE TANK & LINES	SCREENS AND FILTERS	HEATERS	BURNERS	FURNACE AND CONVECTION SECTION	ECONOMIZER	AIR HEATER	Nalco COMBUSTION TREATMENT
Sludge Settling	X		X					Dispersant
Corrosion	X							Corrosion Inhibitor
Sludge, Varnish and Emulsion Formation	X	X	X	X				Stabilizer
Cleaning (Heavy sludge & deposits)	X							Solvent and Dispersant
Soot					X			Combustion Catalyst
Slag					X			Inhibitor for SO_2 to SO_3 Reaction and High Melting Point Materials
Low Temperature Deposits and Corrosion						X	X	Inhibitor for SO_2 to SO_3 Reaction and Neutralizing Materials

Low-cost fuel oil will not become an expensive cause of power plant maintenance and replacement costs when you put Nalco treatments to work controlling sludge, deposits, corrosion, soot, slag or acid formation. There is a Nalco treatment for each of these specialized jobs . . . to provide you with effective protection from storage to stack.

Pre-Flame System

Storage tanks and the pre-flame fuel system can be kept deposit- and corrosion-free with Nalco sludge dispersants, corrosion inhibitors and stabilizing treatments. Where sludge deposits have built up in tanks, there are Nalco treatments that will disperse them into usable fuel and recover lost storage space. Stabilizers and dispersants assure better burning by preventing fouling of burners by varnish or sludge.

Furnace and Convection Area

Soot and slag deposits are common troubles caused by untreated residual fuel oils. There is a Nalco treatment for control of each of them . . . to substantially boost efficiency and reduce mechanical cleaning costs. Combustion catalyst type treatments lower soot ignition temperatures . . . assure more complete combustion, cleaner burning. Slag deposits are substantially reduced by additives that modify the high temperature chemical reactions of ash and sulfur in the oil.

Economizer and Air Heater Sections

Keeping corrosion and acidic deposits out of economizers and air heaters was often the most difficult part of plant combustion problems to solve economically—until Nalco developed successful "cold-end" treatments. Inhibitor-neutralizers modify the chemical reactions which convert sulfur dioxide to the sulfur trioxide that creates corrosive conditions in low temperature areas.

Long Range Economy

Residual fuel oils, *plus Nalco fuel oil treatments*, can build a very attractive operating-cost picture in your plant. For a flying start toward long-range fuel economy, call your Nalco Representative today, or write us for details on *specific* Nalco answers to your combustion problems.

NALCO CHEMICAL COMPANY
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for safety. Panelboards accommodate reversing or non-reversing starters, sizes 0 to 4; circuit breakers to 225 amp; switches to 200 amp (600 amp bolted). Available wired and assembled or as separate enclosures and components. Bulletin SD-80 gives details.

25—Thermostatic steam trap prevents steam loss

For vacuum to 150 psig and up to 425 F, the N-150 of W. H. Nicholson and Co. is designed primarily for tracer lines, and small pieces of steam processing equipment. It comes in ½- and

¾-in. sizes and operates on a true balanced pressure principle. Trap has cast steel body and forged steel cover, with bellows of Monel for corrosion resistance. Baffle is designed to deflect live steam upward, resulting in fast, snap-closed action and greater steam saving. Trap installs horizontally or vertically (claimed freezeproof in this position.)

26—Do-it-yourself transformer in 1000-va capacity

Flexiformer Packaged Transformer Primary Type TP1000 is designed by The Superior Electric Co. for use as a temporary or permanent source of a-c

voltage or current transformer. The required number of winding turns are merely hand-threaded through the center opening. When used as a source of a-c voltage, input rating is 120 v, 50/60 cycles single phase, output rating is 1000 va. Each turn of the hand-wound secondary supplies 0.75 v at 120 v input. When used as a current transformer, the Flexiformer winding be-

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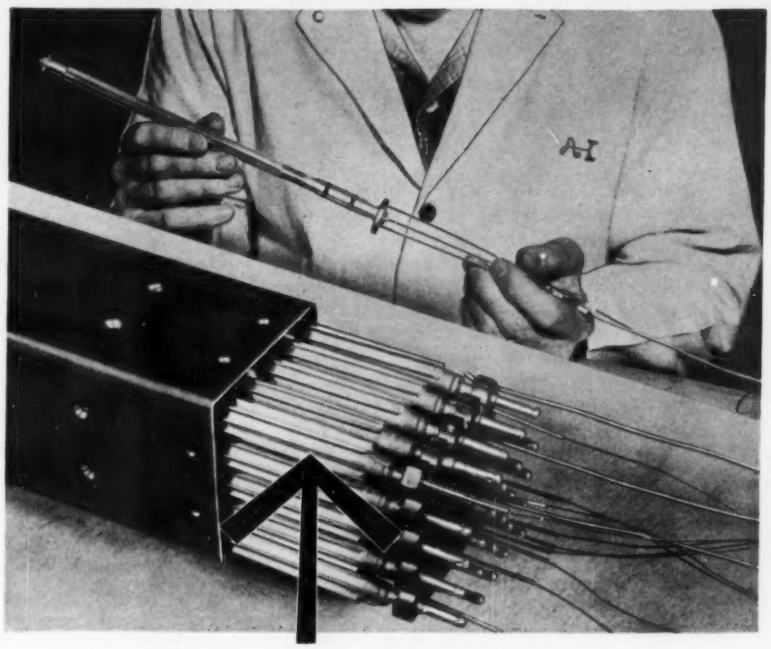

Atomics International's nuclear fuel elements operate at 900°F with new Alcoa finned tubing

This finned Alcoa® Aluminum tube, being checked by a technician of Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif., will go into a nuclear fuel element for organic moderated and cooled reactors operated for the Atomic Energy Commission. Fabricated by Alcoa from APM (aluminum powder metallurgy) alloys, the remarkable tubes permit reactor operation at temperatures up to 900°F, marking an important step forward in the development of economical power from atomic energy. Tests pointed up other features of Alcoa APM alloys: high thermal conductivity, low neutron absorption, excellent corrosion resistance in organic coolants. For more about aluminum's other advantages, please send the coupon.

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☐ 24-10551 *Impacts—Metal in Motion*

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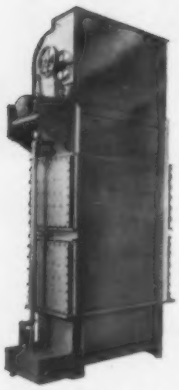
Air-Cooled Heat Exchangers Bring You Extra Savings



Your Niagara Aero Heat Exchanger sets you free from dependence on a costly cooling water supply and solves the problem of water disposal. It pays for itself quickly and its long-lasting quality and dependability keep it constantly saving money for you and adding to your profit.

This Niagara design also saves you much labor and money in installation and upkeep. Its cleanable coils are easily accessible, as are all interior parts. Its panels are removable for cleaning and painting. It is easy and inexpensive to keep in "new machine" condition.

Niagara Aero Heat Exchangers have been making good records as revenue producers and cost savers for their owners for more than thirty years. Use them wherever you need to cool a liquid or a gas in industry.

Write for bulletins 120 and 132.

NIAGARA BLOWER COMPANY

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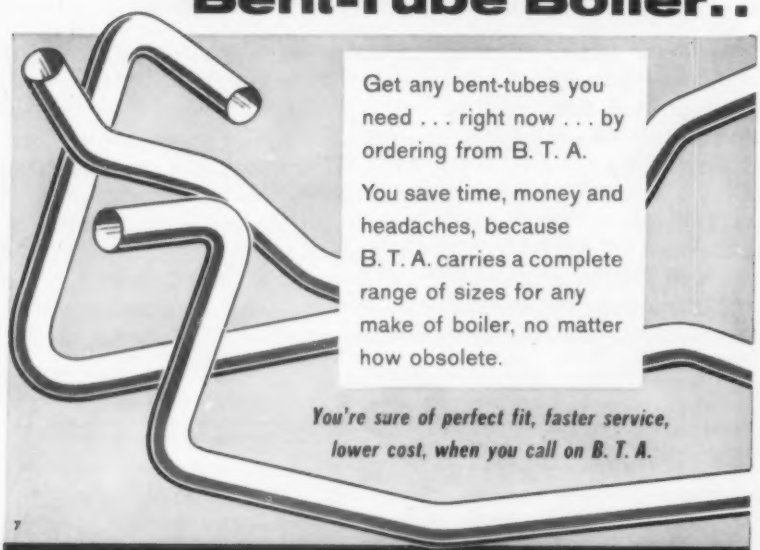
If yours is a Bent-Tube Boiler..



Get any bent-tubes you need . . . right now . . . by ordering from B. T. A.

You save time, money and headaches, because B. T. A. carries a complete range of sizes for any make of boiler, no matter how obsolete.

You're sure of perfect fit, faster service, lower cost, when you call on B. T. A.

BOILER TUBE COMPANY OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

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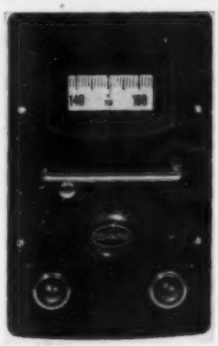
comes the secondary winding and a current carrying conductor passing through the center opening serves as the primary. For continuous duty the maximum ratings are primary current 800 amp, secondary current 5.0 amp with a 160/1 primary to secondary ratio at an accuracy of 1 per cent at 60 cycles. For intermittent duty, maximum ratings are primary, 1600 amp; secondary, 10.0 amp.

27 — Temperature controller from —150 to 1050 F

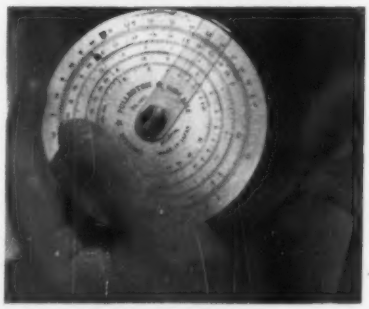
The Pt Temperature Controller—a resistance bulb signaling type—is announced by Technique Associates as the smallest and lowest cost 22-in scale



unit. It offers a choice of on-off or proportioning control over the range and each unit requires less than 5-by-8 in. panel space; three will fit in a 9-by-19 in. rack panel. Features include interchangeable printed stainless steel scales in 1-deg graduations and 300-deg spans, one probe for all ranges, transistorized circuitry, platinum resistance thermometer sensing element, plug-in construction and low power requirements.

28—Circular slide rules promote faster, easier calculation

Acudials combine characteristics of both straight rules and conventional circular ones. Their principle of moving scales is the same as that of the straight rule.



Their revolving disc construction eliminates extra settings required by conventional circular rules, but retains the endless scale concept which eliminates resetting required by running off scale on a straight rule. You can operate an

Acudial with one hand. Six models provide scale arrngements suited to various kinds of work, range in price from around $1.75 to $5.50. Acudials are a development of Fullerton Engineering Sales Co.

Reader Service Cards on pages 91-92 make it easy to get further information on any of these products. Just circle the item numbers of the products you would like to know more about.

29—Low voltage capacitors are light in weight, compact

This line of industrial power capacitors, of General Electric Co., comes in dustproof, weatherproof or exposed-bushing models and features expanded ratings from 2½ to 15 kvar at 230 v, and 5 to 25 kvar at 460 and 575 v. Prices range from $6.76 to $15.20 per kvar for the

460- and 575-v dustproof units, and from $16.33 to $30.00 per kvar for the 230-v dustproof types. New manufacturing techniques and improved capacitor paper make possible the small size and light weight—a 25-kvar unit is the same weight and size as company's former 20-kvar style. New current limiting high interrupting capacity fuses permit use of the capacitors on virtually any industrial power distribution system, according to manufacturer. The capacitors are adequately fused to handle higher short circuit current which will develop as the load grows and the transformer or generating capacity is increased.

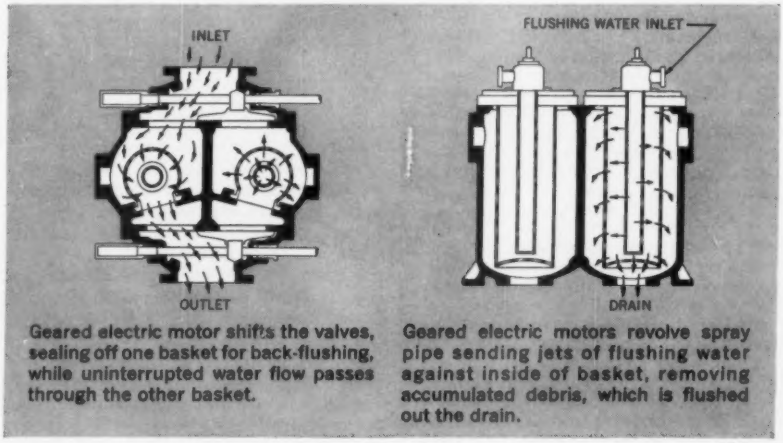
30—Alarm scanning and digital recording systems for utilities

Standard Series 7000 Digital Data Recording and Alarm Scanning Systems announced by Monitor Systems, Inc., utilize the "building block" technique throughout. Through use of the modular design principle, Series 7000 can meet accuracy, speed and reliability specifications of most utility monitoring applications without costly overdesign, according to Monitor Systems, Inc.—on practically an "off-the-shelf"

Elliott motorized back-flushing twin strainers

FOR HEAVY-DUTY INDUSTRIAL SERVICE

● This Elliott type A Twin Strainer is built to handle 2000 gpm of river water ● provides continuous flow of clean water for New Jersey industrial plant ● geared electric motors shift the valve discs and operate the rotary spray pipes ● this design is capable of handling extremely bad water ● one basket is automatically cleaned while water flows through the other basket, assuring continuous service.



Geared electric motor shifts the valves, sealing off one basket for back-flushing, while uninterrupted water flow passes through the other basket.

Geared electric motors revolve spray pipe sending jets of flushing water against inside of basket, removing accumulated debris, which is flushed out the drain.

AO-2

Contact your nearby Elliott District Office or write Elliott Company, Strainer Department, Jeannette, Pa., for complete descriptive details.

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GENERAL OFFICES: JEANNETTE, PENNSYLVANIA
PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio
TURBINES • GENERATORS • MOTORS • COMPRESSORS • TURBOCHARGERS
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THE LONERGAN LINE

HOW TO SAVE WEAR AND TEAR ON MEN AND VALVES

by A. J. Schmidt, Chief Engineer

Power plant users of relief valves in liquid service are undoubtedly all too familiar with chattering. Valves hammer away, annoying plant personnel and running up maintenance bills.

Even with this undesirable operation,

these valves have been acceptable for application where the valves are seldom, if ever, called upon to relieve. For use under critical applications, such as pump-by-pass, where the valve is normally open, or where opening is a common occurrence, it has been necessary to use expensive diaphragm or piston operated valves to eliminate objectionable chattering.

A new series of valves, called Lonergan Hydro-Valves have been under test in dozens of leading plants for the past three years. As a result, Lonergan can provide power plant operators with a valve that is guaranteed not to hammer, chatter or drum on any application, by-pass, or emergency relief. At the same time, full-rated liquid flow is maintained. The chatter free operation is provided by a patented, unique design of throat, seat and baffle construction. Use of the Hydro-Valve helps to: save human nerves; prevent loss of plant fuel or product; reduce maintenance on valves and piping; and eliminate interference with delicate control systems. Hydro-Valves are available in all regular body and trim materials in sizes ranging from 1 to 8 inches.

Full details and descriptions are available in our new Hydro-Valve bulletin. Why not write for your copy today?

Alvin J. Schmidt

Lonergan

J. E. LONERGAN CO., 207 RACE STREET
PHILADELPHIA 6, PA. SINCE 1872

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basis. Series 7000 can be used to scan voltage, demand, wattage, var, temperature or other variables reducible to electrical form at speeds from those of typewriter readout devices to speeds of magnetic tape recorders. Systems with accuracies to 0.01 per cent are announced. Electrical inputs from primary instruments, such as potential transformers, punch-type demand meters, thermoverters etc. can be scanned and converted into digital form.

31—Distribution breaker with improved interrupters

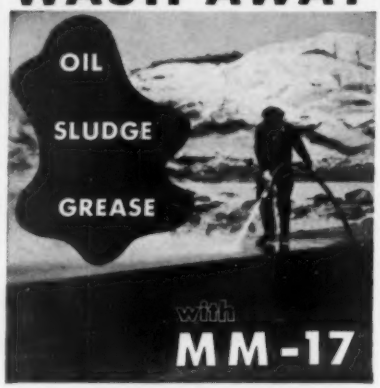
Trend-Line 14.4 is a 23-kv, 100-500 mva breaker announced by I-T-E Circuit Breaker Co. as offering high performance, five-cycle arc interruption, reduced maintenance and a compact "package." At the heart of the new design are I-T-E's Kool-Arc interrupters, formerly available only in sub-

transmission breakers, said to provide shorter arcing time, less contact erosion and minimum oil deterioration. In addition, these interrupters have high-strength fiber glass tubes with internal parts mechanically keyed to the tube so that only a single locking ring is required. Contacts are readily accessible by loosening four bolts on the interrupter. Two interrupters are provided for each phase.

32 — Detachable fittings for high pressure hose

Iron Mike, offered by Aeroquip Corp., has low initial cost plus reusability. For use with company's 1509 Hose, a multiple wire braid, high-pressure type, comes in 10 end fitting styles, including male pipe, JIC swivel, JIC male flare, SAE straight thread, JIC swivel elbows (both 45 and 90 deg), split flange fittings (straight, 45 and 90 deg). Basically, the Iron Mike has three components: a tapered steel socket, which is pushed over segments during assembly to form a rugged compression fitting that won't blow off; two aluminum segments which grip hose reinforcement, and mate with nipple assembly; and a steel nipple (without threads) which fits into hose. The

WASH AWAY



Sea wall at Scituate, Mass., where heavy deposit of bunker oil from sunken tanker was completely removed by spraying MM-17 on oil and hosing off with water.

- **Quickly and safely emulsifies oil spills**
- **Flushes clean with fresh or salt water**
- **Non-explosive, no toxic vapors, does not burn skin**

MM-17 overcomes emergencies caused by oil spills on land or water. It is the safest and most efficient emulsifier extensively used for this purpose.

MM-17 cuts through deep layers of heavy oil and sludge where ordinary solvents fail. Here is a scientific cleaner for oil tanks, pipe lines, piers, loading platforms and oil handling equipment.

MM-17 is sprayed or brushed on the surface to be cleaned. In minutes, oil and grease can be hosed off or wiped away.

Get ready now for annual clean-up and emergencies. Order MM-17 today and have it on hand when you need it.

Write today for free sample and descriptive literature.

FREE Barrel Drain Truck with first order. Listing for $31.50, this truck is yours free with your first drum of MM-17.

ROCKLAND INDUSTRIES, INC.
CHEMICAL DIVISION
63 Grove Street
Rockland, Massachusetts
TRiangle 8-8340

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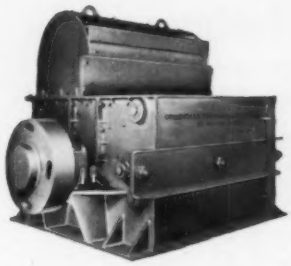
This GRUENDLER CRUSHER handles

600 TONS OF COAL PER HOUR WITH EASE!



This is one of a complete line of Gruendler machines for crushing and conditioning coal for cyclone burning. Specified by many consulting engineers because:

Lower original cost
Lower maintenance
Top performance and production

GRUENDLER CRUSHERS ARE BEST

Write for Bulletin 154
GRUENDLER CRUSHER & PULVERIZER CO.
2915 N. Market • St. Louis 6, Mo.

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DESIGNED FOR STEAM TURBINE TESTING

TYPE WG DEAD WEIGHT PRESSURE GAGE

Please request data sheet 593

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1051 POWER AVE.
CLEVELAND 14, OHIO

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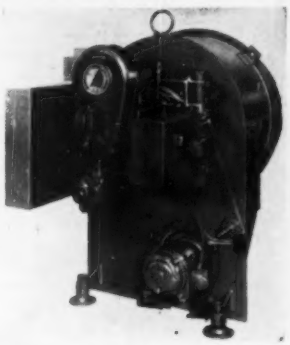
variable component is the nipple, supplied in 10 end styles. These fittings are for hose sizes from ¼ to 2 in. Bulletin 651 gives further information.

33—Package combustion system installs in small space

The Forced Draft Thermopak is a compact, fully integrated packaged combustion system developed by Preferred Utilities Mfg. Corp. It will con-



vert a high or low pressure boiler, large oven or dryer to automatic operation, utilizing fuel oil, gas or combination oil/gas. It is intended for applications where natural draft is inadequate or induced draft unavailable, and may be applied to any firebox where pressure does not exceed ¾-in. wc.

Burner and its accessories, fan and motor, and control cabinet are mounted on the extension front. An inset multiblade fan supplies secondary air for combustion and a shutter-type primary air and a vortex secondary air metering device provide regulation and metering of fuel. The unit is available with four models of horizontal rotary oil burners, a nozzle mix type gas burner or combination oil/gas burner in 10 sizes with maximum capacities from 15 to 175 gph for oil, 25,500 cfh for 1050 Btu gas.

34—Clamps have non-slip coating of Neoprene rubber

Blanket and wire clamps in the Bulldog line of Charleston Rubber Co. are now available with a non-slip coating at slight additional cost. The coating is obtained by dipping the clamps into a roughening solution of Neoprene rubber, then subjecting it to heat, which cures the rubber and bonds it to the wood. The coated clamps are claimed resistant to oil, water, creosote.

CLASSIFIED ADVERTISING

"CHIEF ENGINEER, experienced in designing turbo blower, industrial vacuum cleaner and pneumatic conveying systems. To head up new sales division. Reply Box No. 1742." Power Engineering, 308 E. James St. Barrington, Illinois.

REMOVE OXYGEN

FROM
BOILER WATER...

DEOXY-SOL

Fairmount DEOXY-SOL, a solution of hydrazine, is a high efficiency oxygen scavenger designed especially for high pressure boiler water treatment.

DEOXY-SOL removes oxygen, reduces oxides and raises pH of the condensate all at the same time . . . yet adds no solids.

Stocks in Newark, N. J., Chicago, Ill., Los Angeles, Calif. Investigate its advantages for your system. Write for Bulletin BW.

Fairmount
CHEMICAL CO., INC.
136 Liberty St. New York 6, N. Y.

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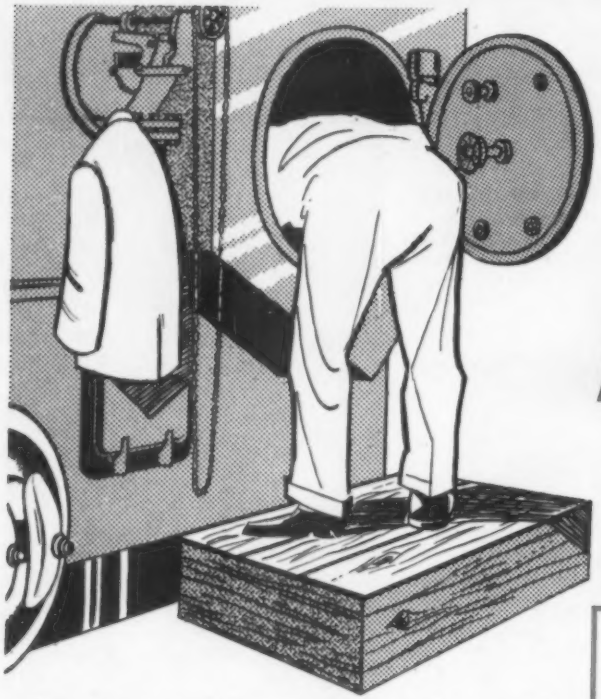
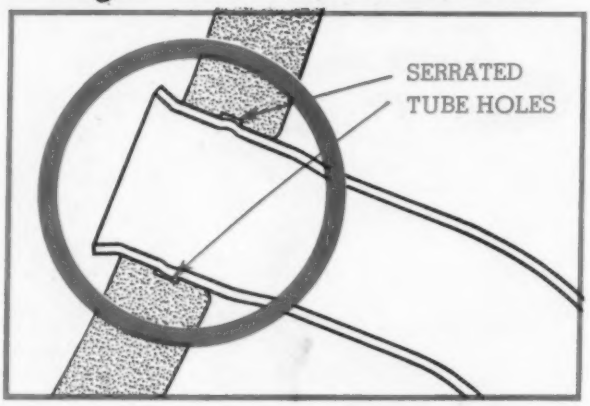


You'd have to CRAWL INTO THE BOILER to see these features which make SUPERIOR "TYPE D"

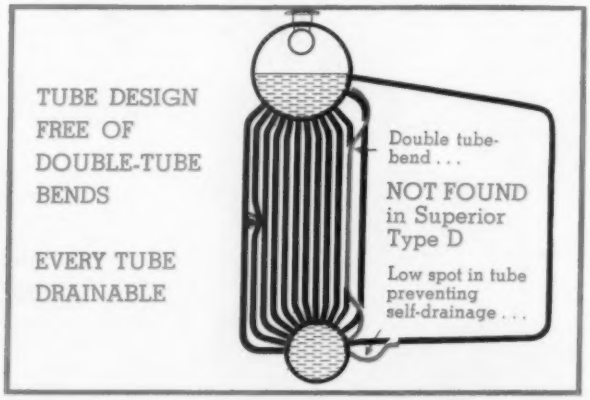
Completely Packaged Boiler

longer-lived and trouble-free

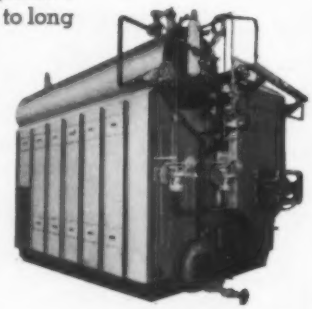


Even if you crawl in, you won't see the serrated tube-holes which provide protection from tube leakage and its resultant caustic embrittlement . . . yet, as you would expect in a quality boiler, they are part of the Type D Superior Packaged Boiler.

Another hidden quality feature is its tube design, shown at right. Note that there are no double tube-bends (shown in red) exposed to radiant heat . . . a characteristic of many water-tube boilers which increases susceptibility to scale formation. Note that every tube is self-drainable (eliminating need of separate blowing operation in cleaning). All tubes provide maximum vertical length with minimum number of bends.



Not all features of Superior's Type D which contribute to long life and trouble-free performance are obvious from the exterior. Some are buried deep inside the boiler . . . but they are there to assure you of the performance you have come to expect from Superior Packaged Boilers.



For condensed data describing the World's Most Complete Line of Packaged Boilers write today for Catalog S-12

Fire-Tube and Water-Tube PACKAGED BOILERS

for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.

TIMES TOWER, TIMES SQUARE, NEW YORK 36. N. Y.

SUPERIOR PACKAGED BOILERS ®

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Power Engineering

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Boilers and Auxiliaries

201 Steam Generator—Bulletin F-14 contains 32 pp of detailed information on E. Keeler Co.'s water tube type steam generator. Photos and diagrams illustrate design and construction.

202 Integral-Furnace Unit — Bulletin G-94, The Babcock & Wilcox Co. describes Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr at up to 1150 psi and 900 F.

203 Packaged Boilers—A complete discussion of firetube boilers — from construction features to final test and start-up service—is presented in 12-pp Bulletin Form AD-178, Cleaver-Brooks Co. Color cutaway shows features of packaged boilers through 600 hp.

204 Automatic Boiler — Application of the Coal-Pak automatic package boiler to low-pressure steam heating, hot water heating, and high-pressure process steam is covered by Bituminous Coal Institute in 36-pp Guide specifications GS-3.

205 Air Preheater — Package air preheaters for small boilers and process applications are featured in 14-pp booklet by The Air Preheater Corp. Fuel savings data, diagrams of arrangements and details of design and operation presented.

206 Packaged Steam Generator — Design and construction details, tables of capacities, dimensions, weights on a compact, portable shop-assembled water tube boiler with integrated firing equipment and controls are presented by Henry Vogt Machine Co. in 10-pp Bulletin PSG-3.

207 Package Hot Water Boiler — Type CC packaged hot water boiler for capacities from 670,000 to 11,720,000 Btu/hr is illustrated and described in 12-pp Bulletin D-2180 of Superior Combustion Industries, Inc. Gives typical boiler room layout, dimensions.

208 Hot Water Boilers — Twenty-pp Brochure HCC-2 of Combustion Engineering Co., Inc. describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler. The unit is for supplying high pressure, high temperature water.

209 Boiler Check List—This check list offered by Cleaver-Brooks Co. is designed to give tips on keeping a boiler clean and operating efficiently. Tells how to obtain better performance.

210 Heat Transfer Equipment — Design and construction features of heat transfer equipment are detailed in 20-pp Bulletin HE-8 of Henry Vogt Machine Co. Covers the positive seal baffle, film type heat exchangers, waste heat, boilers, high pressure and high temperature heat exchangers, exchangers of special alloys.

211 Heat Exchangers — Shell and tube heat exchangers, including copper base alloy, steel and stainless steel fixed tube bundle heat exchangers, are described by The Young Radiator Co. in 16-pp Catalog 1258A. Includes pressure ratings and material specifications.

212 Boiler Piping Hook-Ups—Facts about right and wrong piping hook up, testing, trouble shooting and replacements are covered in Bulletin M-88, a 20-pp pocket guide prepared by McDonnell & Miller, Inc. Gives examples of abnormal conditions and tells how to correct them.

213 Air-Powered Blowers — Bulletin 1067 describes air-powered rotary soot blowers made by Copes-Vulcan Div., Blaw-Knox Co. Includes external and sectional views of the soot blowers.

Cooling Towers

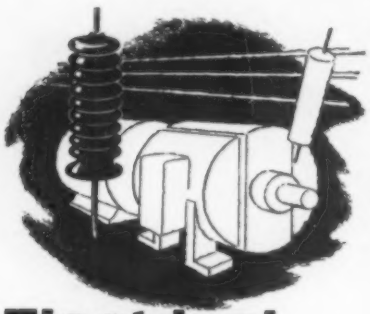
214 Cooling Tower Economies — Presented by Hamon, Inc. in this 12-pp bulletin is a discussion of economic comparisons on cooling towers for a utility. Compares natural draft and mechanical draft towers to various approaches and includes detailed cost comparison curves.

215 Cooling Towers — Advantages of mechanically induced-draft counterflow cooling towers are presented by Foster-Wheeler Corp. in Bulletin CT-57-1, 30-pp. Includes range of sizes, choice of casings, performance data.

To use Post Cards, circle item numbers of catalogs wanted

216 Double-Flow Aquatower — Bulletin DFA15-60 describes The Marley Co.'s double-flow Aquatower designed to bridge the gap between standard double-flow Aquatowers and unlimited capacity industrial cooling towers. Specifications included.

217 Cooling Towers—Performance details on cross-flow cooling towers of The Marley Co., are presented in this 20-pp illustrated Booklet CF-59. Discusses and illustrates through diagrams the cross-flow principle of water cooling; describes equipment, engineering and design features.



Electrical

218 Induction Motor Selector — Selection, application and buying information on General Electric Co.'s Tri-Clad '55 motors, single- and three-phase, from ¾ to 150 hp is given in 14-pp Bulletin GEC-1049. Includes chart for various loads and ambient conditions, tables for dimensions, prices, characteristics and performance.

219 Motor Selection Guide — This pocket-size card (GED-3909A) provides quick reference to frame size (182 to 445U) and book price for General Electric Co.'s a-c- motors from ¾ to 125 hp. Data are tabulated for both drip-proof and totally enclosed fan-cooled Tri-Clad '55 squirrel cage, horizontal motors.

220 Shielded A-C Motors — Comprehensive 56-pp Catalog 200, Sterling Electric Motors, Inc., includes complete dimensional, selection and application data on Multi-Shielded a-c motors. Includes information for various modifications, such as specialized mountings.

221 Synchronous Motors — Advantages of The Ideal Electric & Mfg. Co.'s high speed synchronous motors are detailed in 12-pp Bulletin 501. Cutaway view illustrates component parts and details of maintenance and operation.

222 Pump Motors—This 34-pp brochure of U. S. Electrical Motors Inc. consists of a collection of technical articles on pump motors, illustrated with charts, diagrams, graphs, tables, and cutaways. Subjects range from turbine pump motor lubricants, pump motor bearings, to pumping stations.

223 Motor Application Guide — Sixteen-pp Bulletin 270B outlines characteristics of Century Electric Co. motors of 1/20 to 400 hp and includes up-to-date design information on them. Discusses factors in motor selection.

224 FHP Motors — Twelve-pp Bulletin GEA-6424A discusses features and advantages of General Electric Co.'s fractional horsepower, Form G, general purpose motors, including capacitor start, split-phase, permanent-split capacitor, shaded-pole and polyphase.

225 Wire and Cable Data—These composite, color-coded data sheets contain information formerly found only in many catalogs on wires, cables and power cords. Prepared by Continental Copper & Steel Industries, Inc., data sheets give prices, stranding, strand diameters, temperature ratings, weights.

226 Portable Cords, Cables—Specifications and characteristics of various portable cords and cables are presented in this 52-pp booklet of Kaiser Aluminum & Chemical Sales, Inc. Gives pertinent data on insulation and jacket compounds, and includes tables giving properties of 600-v portable cables, also 601-5000-v portable cables, and others.

227 Insulated Cable—Latest information on cables insulated with a butyl-base high voltage insulation for extreme resistance to ozone, heat and moisture is available in 48-pp Reference Manual 1131, The Okonite Co. Contains data on current carrying capacities, dimensions and design.

228 Cable Splicing Fundamentals —Illustrated with step-by-step photos, this 30-pp booklet of The Okonite Co. explains procedure for splicing and terminating rubber-Neoprene cables, shielded and unshielded. Also includes tape selector and estimating charts.

229 Rigid PVC Conduit — Applications of rigid polyvinyl chloride in the electrical field are detailed in this 20-pp bulletin released by Kraloy Plastic Pipe Co., Inc. Included are comprehensive test results, specifications, installation tips, corrosion-resistance charts.

230 Why Plastic Conduit — Advantages of using plastic conduit in a variety of electrical applications are detailed in this 6-pp bulletin of Southwestern Plastic Pipe Co. Mechanical, physical and electrical properties and other data are tabulated.

231 Unit Substations — Comprehensive Workbook PSG-6001, 24-pp, aids in planning articulated unit substations for secondary distribution, and features a suggested specification form detailing data for a properly coordinated substation system. Detailed specifications provided by Pennsylvania Transformer Div., McGraw-Edison Co., for incoming supply sections, transformer sections and outgoing feeder assemblies.

232 Transformer Tips—General information, operating and maintenance tips and connections for pole type distribution transformers are presented by Allis-Chalmers Mfg. Co. in 52-pp Pocket Manual 61X9659. Includes helpful tables and engineering charts.

233 Unit Substations — Detailed information on features, operations and application of selectively-coordinated load center unit substations providing continuous power for a-c distribution systems is presented in 32-pp Bulletin GEA-3592L of General Electric Co. Compares types of load center arrangements and explains how selective coordination of load centers can be provided on any of four basic power distribution systems.

234 Electrical Distribution — Comprehensive information on electrical distribution products is presented in this 60-pp catalog of I-T-E- Circuit Breaker Co. Divided into three main sections covering molded case circuit breakers, individually-enclosed low-voltage power circuit breakers, and engineered products, it contains selection and application data.

235 Electrical Distribution, Control—Complete with photos, tables of specifications, pricing information, wiring diagrams, this 155-pp reference catalog of Federal Pacific Electric Co. covers 30 types of products. They include circuit breaker load centers, fusible service equipment, enclosed safety switches, low voltage fuses, molded case circuit breakers, enclosed industrial breakers, wall mounted air breakers, others. Book is available to qualified power engineers.

236 L-V Distribution Equipment—General Electric Co.'s 84-pp, 1960 Buy Log covers low-voltage distribution equipment. It serves as a condensed buying catalog for service entrance equipment, light and heavy duty safety switches, tumble and open-knife switches, hinged wireway, circuit breakers, switchboards, motor control centers, sectional distribution centers, panelboards and busway.

237 Industrial Power Systems — Principles of planning industrial power distribution systems for safety, reliability and economy while retaining flexibility and provisions for future expansion are outlined in General Electric Co.'s 48-pp Bulletin GEA-7139. Chapters cover choosing voltages, short circuit calculations, protective relaying, substation selection.

238 General Purpose Controls — Catalog 1260D, 72 pp, contains information on general purpose control devices available from General Electric Co. Charts are listed for motors from ¼ through 200 hp, affording quick selection of heaters and push button stations. Product descriptions are provided for both manual and magnetic motor starters, relays, solenoids, limit switches, push buttons, static control and pilot devices. Prices included.

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239 Low-Voltage Switching — Twenty-pp Electrician's Manual RM-610 offered by Remcon Div., Pyramid Instrument Corp., contains an introduction to low-voltage switching. Explains how company's remote-control switching works electrically, how components are mounted.

240 Electric Motor Controls—Pocket Catalog 60, published by Furnas Electric Co., 56-pp, gives descriptions, ratings, prices for manual and magnetic starters, drum controller, pressure, foot and limit switches. Included are push buttons, related pilot devices, motor rating, heater coil data, and selection tables.

241 Reduced Voltage Starter — Eight-pp Bulletin GEA-6860, General Electric Co., defines reduced voltage starters, tells when and where to use them and how to select them. Contains starter selection table and comparison table. Shows the manual autotransformer, magnetic autotransformer.

242 Electric Motor Controls—Contained in 72-pp Catalog 5900 of Furnas Electric Co. are selector charts for magnetic and manual starters, giving horsepower, motor speed, heater size, heater ampere ratings, enclosure choices. Covers manual starters, magnetic controls, drum controllers, pressure switches, others.

243 Interrupting Capacity Chart — This chart, prepared by Westinghouse Electric Corp., aids in selecting and ordering proper circuit breaker for each application. Interrupting ratings, available fault currents covered.

244 Circuit Breakers — Low voltage stored-energy power circuit breakers are discussed by General Electric Co. in 20-pp Bulletin GEA-5915E. Includes photographs, diagrams, graphs, charts showing specifications, operating features, dimensions, ratings for low voltage power circuit breakers.

245 Maintaining Electrical Equipment — Maintenance and inspection practices to foretell and prevent failure for different types of electrical industrial equipment are described by Associated Research, Inc. in 52-pp Manual D-62. Illustrated by graphs, tables and photos, it contains comprehensive data on methods and instruments for voltage breakdown tests and measuring insulation leakage at high voltage.

246 Electrical Equipment Guide — Describing heavy duty electrical transmission and distribution equipment for commercial, industrial and other installations, this catalog digest of Continental Electric Equipment Co. contains detailed specifications. Presents interrupter, switches, medium voltage switchboards, unit substations, power centers, low voltage switchgear, panel type switchgear, bus ducts, bus plugs, motor control centers, others. Available to qualified power engineers, please state your job title.

247 Basic Electrical Protection — Ten-pp Bulletn BPB issued by Bussman Mfg. Div., McGraw-Edison Co. gives information on motor protection, system selectivity to faults, fuse application and fuse selection. Tells how to coordinate opening time of protective devices so that a fault current will be isolated to the circuit of origin.

248 Overload Fault Currents—Sixteen-pp Section 7 of an aluminum conductor engineering data series offered by Aluminum Co. of America, discusses over-load and fault current limitations of bare aluminum conductors. Includes graphs showing maximum allowable time for various emergency or short circuit currents.

249 Industrial Capacitors—Twelve-pp Booklet B-7642, Westinghouse Electric Corp., answers questions concerning use of capacitors to reduce power costs, increase system capacity, and apply to industry. Subjects cover power factor, benefits of capacitors, how to select capacitors.

250 Grounding Facts—Latest NEC requirements for installation and operation of portable electric tools and equipment is given by The Arrow-Hart & Hegeman Electric Co. in 8-pp "Grounding Facts." Data on revised code requirements and new grounding devices provided.

251 Insulation Testers — Twelve-pp Bulletin 21-45, of James G. Biddle Co., describes models of Meg type Megger insulation testers. These are in the 500- and 1000-v class with sensitivities to 10,000 megohms in the 1000-v instruments. Discusses advantages of insulation resistance testing in electrical maintenance and tells how to select proper instrument.

252 Battery Technology — Bulletin GB-1896 is a 36-pp handbook of technical instructions and engineering data on the care of motive power storage batteries offered by Gould-National Batteries, Inc. It covers all phases of lead acid battery theory, operation and maintenance.

253 Power Supply Handbook — Specifications on regulated d-c supplies, frequency changers (variable frequency power sources) high-voltage power supples (to 600 kv) and other high-voltage products, miniature transistorized power supplies inverters, and converters, and a-c line-voltage regulators are presented by Sorenson & Co., Inc. in this 32-pp book.

254 Silicon Rectifiers — Booklet B-7900, which tells why silicon rectifier packages offer d-c power saving to the electro-chemical and allied industries, is offered by Westinghouse Electric Corp. This 20-pp publication presents detailed description of a silicon power package and states advantages of silicon over other types.

255 Battery Chargers — Selenium or silicon rectifier battery chargers designed for station-type batteries used by utilities and industrial plants are described in this product bulletin of Syntron Co.

256 Electrical Testing Instruments — Twelve-pp Catalog 10-1.3 covers instruments for maintenance, installation and proof-testing of plant electrical equipment. Included are dielectric breakdown tests sets from heavy duty types with a-c or d-c potentials to 150 kv, through mobile, bench and hand-carried portable models. Megohmmeters with ranges to 5,000,000 megohms are presented. Booklet is offered by Associated Research, Inc.

257 Portable Test Units — Presented in this 48-pp booklet of Multiamp Electronic Corp. is detailed information on portable test units for protective relays. Subjects treated include classification of relay tests; preparation for protective relay testing; reasons for an adequate testing and maintenance program.

258 Insulation Materials — Illustrated 36-pp Catalog 34 presents electrical insulation for repair and maintenance of motors, generators, and electrical or electronic equipment. Prepared by Insulation Manufacturers Corp., covers packaged insulation products: cotton, asbestos, and woven glass tapes; cotton, glass and varnished or saturated tubing, others.

These catalogs can be yours without cost or obligation. Use the Reader Service Cards to indicate your choice—just circle the item numbers of those you want.

259 Electrical Insulating Oils — Bulletin 58, 6 pp, gives technical information on Sun Oil Co.'s insulating oils for transformers and cables. Discusses functions of a transformer oil; gassing characteristics of oils, properties of electrical oils.

260 Electrical-Insulating Varnish —This 36-pp catalog of Minnesota Mining & Mfg. Co. covers selection and application of electrical insulating varnishes with complete details on all electrical and mechanical properties, operating temperature limitations.

261 Channel Fittings, Hangers — This pocket-size reference type work manual, about 68 pp, contains product illustrations and correlated information for specifying and using structural support materials for electrical installations. A publication of Steel City Electric Co., it is indexed to areas of application.

Postage-free Reader Service Cards are on pages 91-92

Ventilating, Refrigeration and Air Conditioning

262 Industrial Fans — Fundamental data on industial fans incorporating a universal discharge are presented by Lehigh Fan & Blower Div. of Fuller Co. in 28-pp Bulletin L-5. Included are rating tables giving volumes of air delivered, rpm, horsepower at various static pressures, and outlet velocity.

263 Centrifugal Fans — Catalog 1120-1 of Westinghouse Electric Corp. contains 76 pp of detailed information on all-purpose centrifugal fans with flat, backwardly inclined blading, suited for supply and exhaust, general building ventilation, industrial air conditioning and processes.

264 Plastic Ventilating Equipment —Illustrated and described in 18-pp Bulletin B-500 are plastic ventilation products of Heil Process Equipment Corp. including ventilating ducts, fittings, exhaust hoods, stacks, covers, fans, and fume scrubbers. Physical and chemical properties of glass-reinforced plastics given.

265 Air Engineering — Bulletin E-57, is a 24-pp air engineering data file, offered by Aerovent Fan Co., Inc. Covers engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. Tables for estimating air-handling requirements, losses provided.

266 For Controlled Ventilation — This 20-pp catalog of The Loren Cook Co. is designed as a guide in determining exact type ventilation equipment for specific needs. Guide matches design features with ventilation requirements and conditions.

267 Ventilation and Cooling—Basic principles of ventilation and cooling and definition of American Coolair Corp.'s "breeze conditioning" are presented in 8-pp Form 349. Typical applications in industry are detailed and figures on calculation of air volume required are given.

268 Air Conditioning Equipment — Featured in this product bulletin by Drayer-Hanson Div., Hi-Press Air Conditioning of America, Inc., are fan coil units, central station air handling units, multi-zone air handling units, sprayed coil de-humidifiers. Also shown are hot-cold deck high pressure units, heating and ventilating units.

269 Air Conditioning Units — Detailed information on a packaged central station air conditioning unit designed by American Air Filter Co., Inc. to give exact type and degree of air cleaning is presented in 60-pp Bulletin AC-100. Component features shown, and selection data, including psychrometric calculations, provided.

270 Packaged Air Conditions—Performance characteristics and engineering features are detailed in color-illustrated Bulletin 8825, 12-pp, from American Standard Industrial Div. Typical installation photos showing units with and without discharge plenum are included.

271 Conditioner Units — Design features of Climate Makers, based on the building block principle, are detailed by Airfan Engineering Co. in 60-pp Catalog AHV-59. Gives fan capacities, direct expansion cooling capacities, and coil data, chilled water cooling capacities, chilled water coil data, psychrometric data.

272 Coil Selection Guide — Information on Young Radiator Co.'s water and direct expansion refrigerant coils is given in 28-pp Catalog 5559. Provides selection data on water heating and cooling coils; physical and performance charts; mean effective temperature difference charts. Also includes capacity tables.

273 Air-Cooled Condensers — Four types of air-cooled condenser units are discussed by Halstead & Mitchell in 12-pp Bulletin AC-102—those using propeller fans for horizontal air flow, propeller fans for vertical air flow, centrifugal fans for use with ductwork, and centrifugal fans.

274 Refrigeration Condensers — Engineering data on refrigeration condensers are featured by Henry Vogt Machine Co. in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, freon condensers.

275 Cold Room Conditioning — In Bulletin 95, Niagara Blower Co. describes the No-Frost method of producing temperatures down to —90 F for freezing, testing, cold storage etc., giving advantages. Operation with two- and three-stage cooler covered.

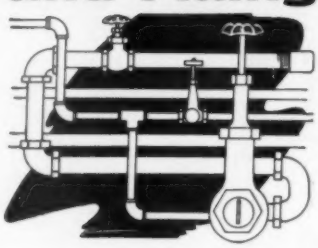
Dust Control

276 Dust Collection, Recovery — Details on dust collecting, recovery and classifying equipment manufactured by Buell Engineering Co., Inc. are presented in this product bulletin. Covers electric precipitators, mechanical collectors, bag collectors.

277 Dust Collecting Equipment — Product data on dust collection, precipitation and gas scrubbing equipment covers electrical precipitators, mechanical dust collectors, others. From Western Precipitation Corp.

278 Electronic Air Cleaner—Twelve-pp Bulletin 405, Dollinger Corp., describes features and advantages of an electronic air cleaner based on the principle of electrostatic precipitation. Diagrams, photos, specifications included.

Piping, Valves and Fittings



279 Valve Selection Tips—In addition to cross indexing company's own line of valves with those of other manufacturers, The Ohio Injector Co.'s Valve Buyer's Guide, 22 pp, contains a list of frequently used abbreviations, a valve trim chart, other data. A breakdown by valve material and pressure class, and classification by type, disc design included.

280 Valve Materials Calculator — Preferred valve materials for different types of corrosives are shown in this calculator prepared by Hoke, Inc. It is designed as a guide to the selection of materials of valve construction, based on "substantial," "moderate," "questionable" or "inadequate" resistance to a chemical at atmospheric pressure temperature.

281 Valve Selection Data — Facts to keep in mind when selecting a valve for a specific application are detailed in Crane Co.'s 20-pp Bulletin AD-2016. Three principal valve types are illustrated and described, and cutaway views showing component features.

282 Valve Guide — Catalog 800-A contains 20 pp of detailed information and technical details on company's bronze valves, as well as pressure and temperature controls, solenoid valves and strainers. Includes descriptive data, comparative chart, estimated weight tables by Detroit Controls Div., American-Standard.

283 Stock Solenoid Valves — Solenoid valves available "off the shelf" from Automatic Switch Co. are presented in 16-pp Stock List and Selection Guide 506. Contains engineering information, simple selection data, illustrations and flow diagram of two-, three- and four-way types, manual reset valves, special valves.

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284 Specifying Solenoid Valves — Included in Valcor Engineering Corp.'s 8-pp booklet on specifying solenoid valves are a description of various types of valve sealing; a discussion of mechanical specification criteria including application description, fluid characteristics.

285 Safety-Relief Valves — Liquid relief and special service safety-relief valves, including a new, low cost compact series, are presented by Farris Engineering Corp. in 28-pp Catalog FE-138. Valves shown include types for hydraulic pressure systems, liquefied gases, chemical corrosive service and general industrial service.

286 Safety Relief Valves — Standard and balanced bellows safety relief valves for industry are detailed by Manning, Maxwell & Moore, Inc. in Catalog 1900, 124-pp. Sizing and selection tables, performance characteristics, orifice and valve capacities, dimensions and weights, pressure temperature ratings provided.

287 Steel Globe Valves — Low-pressure-drop, cast steel valves for large volume, high-pressure and/or high-temperature applications are detailed in 16-pp Catalog 14-B by Edward Valves, Inc. Advantages, pressure ratings, dimensions, weights, specifications are covered; cutaway views provided.

288 For High Pressure, Temperature — Twelve-pp Bulletin B-454 of Yarnall-Waring Co., features Welbond valves for high pressures and temperatures. Dimensions, weights, materials sizes and specifications given.

289 General-Service Valves—Twenty-pp Bulletin E-165 is a guide to Everlasting Valve Co.'s valves for general services. Types, typical applications, construction and operating features are discussed. Generously illustrated with drawings, photos and cutaways.

290 Check Valves — Details and specifications on check valves designed to eliminate water hammer and line surge are presented by Combination Pump Valve Co., in 20-pp Catalog 600. Typical installations are illustrated, and installation data, flow chart, and ratings included.

291 Control Valves — Steam and liquid control valves manufactured by O. C. Keckley Co. are illustrated and described in 56-pp Catalog 58-A. Covers strainers, pressure regulators, temperature regulators, safety and relief valves, pressure reducing valves, diaphragm control valves, solenoid valves, float valves.

292 Valve Guide—Globe and angle, gate, check and other types of valves in bronze, iron, steel and alloys, are catalogued in 24-pp Form 232 of The Wm. Powell Co. Provides selection information, including application suggestions, features, ratings.

293 Water Hammer Control — The Williams Gauge Co., Inc. explains the cause, effect and control of water hammer in piping systems in Bulletin WH-851, 8-pp. Silent check valves for eliminating noise, valves in sizes from 1 to 20 in. and operating pressures to 5000 psi are described.

294 To Control Water Hammer — This 56-pp standard catalog of Pulsation Controls Corp., details mutes, pulse traps, shock traps and blenders. Specifications, applications given.

295 Steam Traps and Vents—Lecture 1A on "Steam Trapping and Air Venting" is offered by Sarco Co., Inc. as a comprehensive treatise on all types of steam traps. Describes operating principle and construction.

296 Steam Traps—This Condensed Catalog of Sarco Co., Inc. contains 12-pp of technical details, dimensions, and capacity data on steam traps, temperature regulators, and heating specialtes. Cut-away views included.

297 Steam Trap Selector — This 32-pp impulse steam trap selector for petroleum processing equipment, released by Yarnall-Waring Co., contains detailed information on how to select, size and install steam traps. Includes trap recommendations, capacity tables.

298 On Steam Traps — Catalog K is an enlarged 48-pp manual and steam trap catalog of Armstrong Machine Works. New material provided includes open float and thermostatic traps, pipe strainer to 6 in. steel and semi-steel, and helpful steam pipe sizing tables. Discusses fundamentals of trapping.

299 Manual on Traps—This 40-pp engineering manual published by the V. D. Anderson Co. is designed to assist in the sizing, specifying and selection of steam traps and other fluid specialties. Includes steam trap selection guide, explanation of four basic types of traps and how they perform.

300 Guide to Strainers — Presented by Tate Engineering, Inc. in this 88-pp handbook are reference data for layout of fluid flow systems and sizing of stainers, tabulated results of testing, and valve and pipe selection information. Reference material for each strainer section is on a foldout page for use with any specific page in that section. Book contains over 100 illustrations, charts, drawings.

301 Self-Cleaning Strainers—Twelve-pp Catalog 6008, on strainers for steam, air, gas and liquids, details over 600 strainers and shows selection of materials, end connections, pressure ratings and sizes. Pressure-drop and pressure-temperature limit data are provided by Leslie Co.

302 Ball Joints — How to solve piping flexibility problems with Barco Mfg. Co.'s ball joints is explained in Bulletin 31B. Thermal expansion and contraction principle is illustrated.

303 Improved Plastic Pipe — Illustrated 10-pp Bulletin TR-2704A, issued by Johns-Manville Corp., contains tables of properties, working pressure, flow chart and other pertinent information for selection of Supreme plastic pipe. Includes tips on cutting, connecting, installing, testing.

304 Good Piping Charted — Recommended piping practices are presented in this wall chart form by The Lunkenheimer Co. Chart is divided into five sections covering basic valve types, connections normally used, installation and maintenance tools, installation, operation and maintenance.

305 Power Piping Erection—Field erection of high-temperature, high-pressure power piping is the topic of this 12-pp bulletin released by The M. W. Kellogg Co. Illustrated with photos and diagrams, it shows how detailed plans are developed, field-erection costs and quality control.

306 Pipe Ratings — Technical Bulletin TB1-1960, 24 pp, offered by The Pipe Fabrication Institute, tabulates pressure-temperature ratings of carbon steel, molybdenum, chrome-molybdenum and chromium silicon molybdenum alloys in all standard sizes of seamless piping. Chemical requirements, in relation to the various types of seamless pipe and weight charts, are included. Available to qualified power engineers.

307 Installing Pressure Pipe — Form TR-62A is a 24-pp installation guide for Transite pressure pipe. Offered by Johns-Manville Corp., covers handling and installation of the pipe from loading and unloading to assembly of pipe and couplings, cutting and machining, service connections, backfilling, testing, repairing. Includes data on site conditions.

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308 Power Piping Equipment — Pipe hangers, vibration eliminators and supports are presented in Catalog 58, 114-pp, by Blaw-Knox Co. with technical section devoted to charts, typical problems and specifications. Component parts and installation instructions given.

309 Pipe Measurement Data—Aeroquip Corp. tells how to measure and relate pipe, tubing and hose sizes in 16-pp Bulletin 631, covering standard methods of measurements, discussing both similarities and differences involved in measuring fittings and fluid-carrying lines to arrive at satisfactory fluid line installations. Standard practices of measuring adapters and complete assemblies are discussed.

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310 Plastic Pipe, Fittings — PVC pipe, valves and fittings and their uses are covered in this 36-pp handbook by Kraloy Plastic Pipe Co., Inc. Specification, design and installation data are included, as well as a comprehensive corrosion resistance comparison chart of seven types of plastic pipe carrying 162 chemicals.

311 Pipe Thread Fittings — Advantages of pipe thread fittings designed to eliminate positioning problems, leakage, and overtightening damage are detailed in this product bulletin of Tru-Seal Div., Flick-Reedy Corp. Common types of positioning distortion, alignment re-working and leakage problems covered.

312 Supports for Piping — Described in 96-pp Catalog 59, is a system utilizing pre-engineered standard components in almost infinite combinations to solve most piping and equipment support problems. The system, introduced by Bergen Pipesupport Corp., affords savings in engineering and field costs, offers simplicity of use.

313 Pipe Alignment Guide — This bulletin of The Align-O-Pipe Guide Co. introduces a device for guiding pipe lines which are expanding or contracting because of temperature changes. Explains how units permit movement of pipe line in an axial direction only.

314 Unions, Fittings — In this 16-pp illustrated catalog, Stockham Valves & Fittings Co. gives complete details on design, weight and dimensions of unions and union fittings. Also included are engineering specifications and information on prices.

Coal

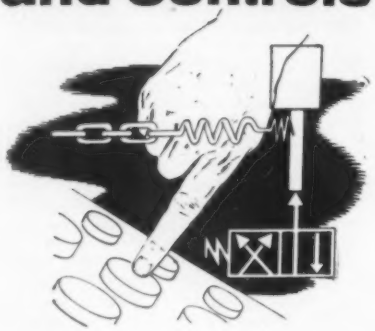
315 Where's the Coal — Peabody Coal Co. has issued a bulletin listing location of its coal reserves. A map shows location of coal reserves for most economical access to fuel supplies.

316 Precisioneered Coal — This 16-pp brochure highlights coal mining, preparation, research and service facilities of Island Creek Coal Co. and includes flow chart of a preparation plant. Also describes 11 brands of coal as to performance and application characteristics.

317 Coal Crusher — American Pulverizer Co.'s WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes construction elements that result in coal reduction at lower operating cost. Tables give capacities, speeds, and dimensions.

318 Water-Cooled Stoker — Design and operating advantages of Vibragrate Stoker are outlined by Detroit Stoker Co., in this illustrated bulletin with cutaway view of details.

Automation, Instruments and Controls



319 Automatic Controls — Comprehensive data on mercury-switch equipped controls for single-stage pressure, two-stage pressure, differential pressure, single-stage temperature, two-stage temperature, liquid level and mechanical movement are presented by The Mercoid Corp. in 56-pp Catalog 860. Specifications and engineering data provided.

320 Industrial Controls — This 88-pp catalog presents comprehensive information on controls, offered by General Controls Co., including automatic temperature, pressure, level and flow controls, as well as counters, switches and automation controls. Other items described are industrial actuators, combustion instrument controls, indicators.

321 Telemetering Systems — Metameter telemeters for remote measurement, recording and automatic control are described in 52-pp Bulletin M1715 of The Bristol Co. Covers principles of operation, types; application to various factors including pressure, water level, temperature, flow, motion.

322 Temperature Controls — Filled with charts, drawings and diagrams, 24-pp Bulletin 101, of the Partlow Corp., discusses industrial temperature measurement and control, including ways of responding to temperature, ways of putting temperature response to work, mercury-bulb instrumentation, basic types of controls, and a score sheet for the mercury-bulb system.

323 Control Systems — Bulletin pH-4314, 80-pp industrial pH handbook issued by Beckman Instruments, Inc., reviews industrial pH control systems, principles, application engineering and equipment. Drawings, dimensions, specifications given.

324 pH Instruments—Bulletin 92-E entitled "What Every Executive Should Know About pH" tells what it is; how it is measured and controlled; and describes Beckman Instrument's pH equipment for every requirement.

325 Instruments and Controls — Catalog 57-6, Republic Flow Meters Co., describes instruments and controls, including flow meters, liquid level or pressure gage, CO_2 meters, boiler meters, pneumatic transmitters, strip chart recorder, pressure, vacuum and differential recorder, others.

326 How to Select Recorders—Buying information on recording instruments of General Electric Co. is provided in 12-pp Bulletin GEA-6933, including dimensions and chart speeds, operating specifications, applications, features and accessories. Also described are specialized instruments—recording vibrometers, automatic oscillographs.

327 Industrial Thermometers — Thermometers for air temperatures, open kettles, vats, ducts, hot and cold water lines, air ducts, test equipment, and plumbing lines are discussed in 8-pp Bulletin 356, of Palmer Thermometers, Inc. Specifications and materials included.

328 Regulator Hook-Ups—How to provide temperature and distillation rate control at least cost with self-operated regulators is diagrammed and described in six application guides A12-14/18, 12-pp offered by Spence Engineering Co., Inc.

329 Guide to Gages — Catalog 300-B, 112-pp, features Ashcroft, Duragauges, Maxisafe, pneumatic receiver, recording, drawn case, chemical and special application gages of Manning Maxwell & Moore, Inc. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided.

330 Pressure Gages — Featured by J. E. Lonergan Co. in 46-pp Catalog 1000G are pressure indicating and vacuum gages for industrial, chemical, and refinery applications. Selector tables give data on various gages and recommended services. Specifications, standard graduation tables, photos, dimension diagrams included.

331 Hydrostatic Instruments — In this 88-page pocket-size handbook of hydrostatic instrumentation, Petrometer Corp. includes information on principles of hydrostatic measurement, selection and installation of instruments, design and construction of panel systems, as well as engineering data and diagrams. Provides tank volume formulae, conversion tables, viscosity charts, hydrometer scales.

332 Test Instruments—Catalog G-10 contains 48 pp of data on recording, measurement, and testing instruments of Minneapolis - Honeywell Regulator Co. Covered are d-c amplifiers, data handling systems, calibration instruments, magnetic tape instrumentation, nuclear instrumentation, oscillographs, recorders and indicators, servo components, temperature controllers.

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333 On Thermocouples — Detailed information on thermocouples and thermocouple components and accessories is contained in 50-pp Catalog EN-S2 of Leeds & Northrup Co. Lists and describes standard assemblies in protecting tubes and wells for general applications; specialized thermocouples and assemblies; and bare and insulated thermocouple wires.

334 Automatic Controls — Selection and application information on automatic controls for steam and water service is presented by The Powers Regulator Co. in 46-pp Engineer's Manual. Covers controls for fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, process hot water, pressure reduction, storage heaters.

335 Timers and Counters — Condensed Catalog D-31 contains 30 pp of reference data on automation components and control systems, covering latest timing components and linear measuring systems. Standard timers and counters are reviewed as well as electronic timers, package control systems, test equipment, switches, controllers, other products of Automatic Timing & Controls, Inc.

336 Steam Temperature Control — Operation and control of high steam temperatures is described in Bailey Meter Co.'s Bulletin 543. Three detailed diagrams explain principle of desuperheater water control and burner tilt and desuperheater water control.

337 Combustion Control Systems — Design and selection of combustion control systems is covered in 32-pp Bulletin 1001 by Reliance Instrument Div., Electro-Mech Corp. Covers proportioning and metering systems, with block diagrams, pointing out advantages, operation, mounting.

338 Nuclear Instrumentation — Detailed information on nuclear instrumentation and accessories is presented in 50-pp Condensed Catalog F of Tracerlab Inc. Covers all phases of nuclear study and includes detectors, counting and radiation analysis equipment, sample changing equipment and necessary adjuncts for personnel protection, monitoring.

339 Turbine Instruments — Bulletin GEZ 3078-1, 12 pp, includes description and specifications of General Electric Co.'s compact redesign of a turbine supervisory instrument system that charts a permanent record of mechanical performance throughout starting and running periods. Detailed description of system's ability to monitor vibration, shaft eccentricity.

341 Fuel Cut-Out Controls — Bulletin D2.5 released by Reliance Gauge Column Co., describes float-operated and electrode-operated fuel cut-out controls combined in one device. It also describes a low water level alarm.

342 Data Processing at Work — Data processing equipment of Leeds & Northrup Co. now in use throughout the country is described in 48-pp Preliminary Technical Publication N-07 (1). Installations covered include digital data processing and analog and digital computing systems. Explains type of inputs, input switching, output devices and operation for electric-power, petro-chemical use.

343 Automation for Utilities—Automated equipment and systems for electric utilities are described in General Electric Co.'s Bulletin GEA-7044, 244 pp. All phases of system operation —generation, transmission and distribution—are covered, as well as automatic load dispatching covering the areas of load-frequency control.

344 Computer Technology — Latest advances in computer technology and equipment are presented by Computer Systems, Inc. in "New Solutions in the Science of Simulation," 20 pp. Features the Dystac (Dynamic Storage Analog Computer), a hybrid computer combining analog computer's speed, lower cost, ease of programming and improved output data presentation, with digital computer's data storage.

345 Computer Talk — This 22-pp glossary of "computerese" — the language of electrical brains — is compiled by Minneapolis-Honeywell Regulator Co. to make computer language more intelligible to the layman. Defines over 82 terms found in the vocabulary of computer engineers.

346 Before the Computer Comes — Prepared by the Philco Corp., this 8-pp booklet tells what to do before installing an electronic data processing system. In non-technical language, booklet describes system analysis, specifications, design and operation.

347 Automatic Programming Systems — Details on automatic programming systems by Bendix Computer Div., The Bendix Corp. are presented in 8-pp Bulletin AR-1060. Characteristics of various systems designed to solve a variety of programming problems are covered.

348 Compiler-Translator — Act I, an electronic algebraic compiler and translator, is described in 18-pp Manual S-520 of Royal McBee Corp. Explains "source" program language—a series of algebraic and logical statements. Stresses simplicity of use, faster programming and solutions.

349 Teaching Servo Systems — A new method of teaching servo systems that bridges the gap between theory and practice is described in 8-pp Special Report SR-3 by Servo Corp. of America. Explains how packaged assembly of electronic and electrochemical components permits students to build and test servo systems, demonstrates formula derivation, characteristics of control systems.

350 Alarm Indicating Monitor — Presented in 8-pp Bulletin MSP-195 by Hagan Chemicals & Controls, Inc. is detailed information on their alarm indicating monitor which combines all alarm functons in one instrument. Includes specifications.

351 Signaling Equipment—Air and electrical signal systems and specifications of horns, bells, buzzers, chimes and sirens are featured in 88-pp Catalog 160 by Sperti Faraday, Inc. Included are sections on gravity drop and lamp type annunciators and accessory equipment, and charts.

352 Annunciator Systems—Well illustrated with photos, charts and diagrams, 52-pp Catalog 100C of the Panalarm Div., Panellit, Inc., presents information on annunciator systems designed to give immediate notification of off-normal conditions in continuous process and automatc operations.

353 Annunciator Systems — Details on operation and use of annunciator system to provide continuous and automatic surveillance of pipeline, chemical and food processing, power generation and distribution is given by The Scam Instrument Corp. in 36-pp Catalog. 659. Types of annunciator sequences are illustrated.

354 Lighting Specifications — Included in the 52-pp RLM Standard Specifications are three new specificatiins for 1500 ma units: D-4 fluorescent semi-direct medium high mounting, SD-3AL semi-direct aluminum, and SD-3PE semi-direct porcelain enamel units. The book contains many upward revisions of existing specifications, and new specifications for aluminum reflectors. Booklet is prepared by The RLM Standards Institute, Inc.

355 Floodlight Data in Brief — Pocket-sized Bulletin 2714 is a 184-pp miniature edition of Crouse-Hinds Co.'s floodlight catalog, and includes all original material. Covers selection of floodlights, general purpose floodlights, heavy duty models, mercury vapor floodlights, special types, lighting for hazardous locations, searchlights, poles, accessories. Includes installation tips, lighting calculations.

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356 Floodlight Selection — How to select and apply floodlights is told by General Electric Co. in 16-pp Bulletin GEA-6175C. Describes floodlight classification, general principles of floodlighting, tells how to calculate light levels for vertical and horizontal surfaces, includes recommended levels.

358 Area Floodlighting — Planning for lighting of parking areas and other open areas is detailed by Crouse-Hinds Co. in 16-pp Bulletin 2719. Contains reference guides for selecting incandescent or mercury floodlights, general purpose or heavy duty types, and for determining how many lights needed.

359 Lighting Maintenance Tips — Principles and advantages of good lighting practice are presented in Champion Lamp Works' 48-pp lighting maintenance manual. Includes guide to trouble shooting, fluorescent installations, tips on planning group lamp replacement, cleaning.

360 Lighting Equipment — Illustrated and described in this 34-pp ringbound lighting equipment catalog is The Wakefield Co.'s line of luminous ceilings, industrial fluorescent units, incandescent and mercury vapor units and other types of fixtures. Includes photometric reports.

361 Lighting for Industry — This 16-pp lighting guide (BLBS Form B-570) issued by Better Light Better Sight Bureau explains in non-technical language what's behind the higher lighting levels recommended for industry. Includes data on recommended foot-candle levels, discussion of quality factors, explanation of benefits.

362 Lighting Design — Twelve-pp Booklet VE-900 of Sylvania Electric Products, Inc. contains data on lighting terms, formulas and design factors in easy-reference form. Photometric tables simplify calculations.

363 Modern Lighting Needs— "Footcandles in Modern Lighting," is General Electric Co.'s 20-pp revised booklet giving lighting level recommendations for seeing tasks involved in hundreds of industrial and other activities. Figures are based on findings of Illuminating Engineering Research Institute and Illuminating Engineering Society.

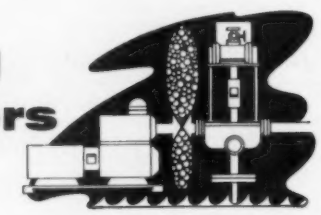
364 Incandescent Lighting — The 24-pp "Incandescent Lighting Guide Book" of Sylvania Electric Products Inc., features sections on the general advantages of incandescent lighting, the history of incandescent lamp developments, and includes chapter on basic types, bulb shapes, sizes, glass types and finishes, and bases.

365 Miniature Lamp Data — This 24-pp pocket size booklet of Chicago Miniature Lamp Works lists standard miniature lamps now available, and the sources of supply. Specifications of lamps (nearly 400) are given, also lamp nomenclature.

366 Lamp Ballast Service — Described by Universal Mfg. Corp. in this product bulletin is a service program for fluorescent lamp ballasts which provides immediate replacement of inoperative ballasts. Also described is a 24-hr engineering service for design consultation, installation assistance.

367 Group Relamping Plan—Eight-pp Booklet A-6832 describes a group relamping plan designed by Westinghouse Electric Corp. to reduce costs, provide better lighting, and cause fewer work interruptions. Sample calculations provide data for setting up a schedule.

Pumps and Compressors



368 Power Plant Pumps — Bulletin BJP-588, Byron Jackson Pumps, Inc., describes standard pumps for all power plant requirements — from 12,000 hp, double-case boiler feed pump, to condensate, circulating and booster pumping duty. Also describes special pumps for nuclear power plant installation.

369 Vertical Turbine Pump — Featured by Worthington Corp. in 16-pp Bulletin 2400-B1 are ultra high flow vertical turbine pumps. Design improvements, which result in broader coverage and higher efficiencies over wider operating ranges, are illustrated.

370 Submersible Pump — Illustrated and described in this 10-pp bulletin are applications for submersible pumps manufactured by Kenco Pump Div., The American Crucible Products Co. Lists physical dimensions, pumping capacities, electrical data and detailed specifications.

371 Rotary Air Pumps — Catalog 460, 32 pp, of Leiman Bros., Inc, describes rotary positive air pressure and high vacuum pumps, gas boosters and air motors. Gives construction details, dimensions, capacities, performance curves for all pumps, engineering data.

372 Simplified Pump Selection — Technical data is simplified and presented in an easily-understood way in the Deming Co.'s rotary pump selection manual. Groups liquids according to viscosity and each classification has its own selection table. Fast selection is possible by matching liquid to pump.

373 Free-Piston Pumps—Features and advantages of an air-operated free-piston pump designed to pump anything that flows are detailed by The Crossley Machine Co. in this product bulletin. Diagrams show operation.

375 Rotary Vacuum Pumps—Features of Consolidated Vacuum Corp's oil sealed rotary vacuum pumps are detailed in 6-pp Bulletin 8—15. Discusses building block construction, ease of maintenance of these pumps.

377 Pump Selection Catalog — Included in 12-pp easy-to-use Circular 184 of Dean Brothers Pumps Inc. are charts showing recommended temperature and pressure ranges for 10 classifications of company's pumps—from —350 to +1000 F, to 1000 psig.

378 Pumps and Controls—Bulletin 220 contains 72 pp of data on design details and operating characteristics of hydraulic pumps, fluid motors and valves offered by Dennison Engineering Div., American Brake Shoe Co. Sections are devoted to types of hydraulic pumps, pumping units, fluid motors, and control valves.

379 Centrifugal Pumps — Single stage, double suction centrifugal pumps are described by Goulds Pumps, Inc., in 16-pp Bulletin 721.6. Complete specifications, interchangeability chart, performance curves are included.

380 Sizing Cooling Tower Pumps— Six steps to be taken in sizing pump and piping of any cooling tower installation are explained by Bell & Gossett Co. in 6-pp Bulletin CT-360. Provides selection charts, tables.

381 Pumping and Hydraulic Data —Definitions, formulae, testing, tables, charts and definitions useful in pumping any hydraulics are covered in 20-pp Bulletin EM-77 issued by Peerless Pump Div., Food Machinery and Chemical Corp. Includes facts on how to figure NPSH, pump efficiency, mechanical and electrical equivalents, and pipe friction loss chart.

382 Close-Coupled Pumps—Twelve-pp Bulletin 1100 of Layne & Bowler Pump Co. describes Verti-Line pumps for vertical pump installations. Gives specifications and features of types with capacities from 30 to 30,000 gpm, heads to 600 psi. Illustrates some installations.

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383 Compressors, Pumps—Twenty-pp Bulletin C-5A, Fuller Co., covers rotary compressors and vacuum pumps. Details construction, performance, dimensions and installation. Compressors range from 300 to 3300 cfm.

384 Compressed Air Fundamentals — Sixteen-pp Form 1548, Ingersoll-Rand Co., is intended to aid in selection of a small "packaged" air compressor. Discusses compressed air, how it is compressed, single- and two-stage compressors, piston displacement, control used etc. Includes information on compressor oils, pipe sizes, wire sizes.

385 Compressor Valve Story—Operation and importance of valves in modern reciprocating compressors are described in 44-pp Booklet Form 3222 by Ingersoll-Rand Co. Questions and answer format details demands made on valves and their function in a compressor. Traces evolution of valving from 18th century types.

386 On Eliminating Explosions — In 12-pp Bulletin 173, Clark Bros Co., presents recent findings on mechanism of explosions in pipelines and compressor starting air lines. Discusses research in nature of explosions and shock waves in piping, and these observations are applied to compressor air starting systems.

Packings, Seals, Gaskets

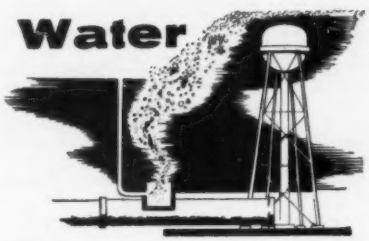
387 Packing Chart — This packing recommendation chart by Raybestos-Manhattan, Inc., shows basic packing types for 95 per cent of all packing needs. Covers such applications as: pumps and valves, high-temperature valve stem and expansion joints, high-speed rotary air compressors.

388 Mechanical Packing Guide — Johns-Manville's 64-pp catalog, Form PK-131A, contains comprehensive information on mechanical packings. Includes chemical selection chart listing more than 700 liquids common to process industries. Also featured is a simplified selection chart.

389 On Boiler Gasket Leakage — Some causes of boiler gasket leakage are discussed in Technical Paper 139 by Betz Laboratories, Inc. Factors to consider in overcoming or minimizing gasket leakage, such as selection of gasket joint, installation, and corrosion protection, are explained in detail.

390 O-Ring Handbook — Catalog 5711 is a 24-pp design and data book of Parker Seal Co. on Viton O-rings. Contains test information on some 150 fluids and gases to which this synthetic elastomer is compatible; recommended design techniques; general information on three compounds; data on all standard sizes.

391 Corrosion Resistance Chart — Over 150 chemicals and their recommended uses with ductile iron, iron, steel 316 and 304 stainless steel, Monel, brass, bronze, copper, aluminum and plastisol plastic are listed in Corrosion Resistance Chart J-CRC. Prepared by OPW-Jordan Corp., chart shows which gasket materials are needed.



392 Water Requirements Calculator — With this calculator (B-659P) you can quickly figure conversion of ppm water hardness to grains per gallon hardness, amount of exchange resin needed, brine and salt requirements, and brine tank size and operating brine level adjustments. Calculator, prepared by Morton Salt Co., can also be used in selecting tank size.

393 pH and Chlorine Control—The 16th edition of W. A. Taylor Co.'s handbook Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and test kits are illustrated. Methods are also outlined for quantitative analyses. Available to qualified power engineers, please state your job title.

394 Boiler Water Treatment — Chemical reduction of oxygen in boiler feed water with hydrazine is the subject of 10-pp Bulletin BW of Fairmount Chemical Co., Inc. Economy and operation, handling of the Deoxy-Sol, methods of analysis covered.

395 Boiler Water Analysis — This data sheet released by Technicon Controls, Inc. outlines a means of securing continuous analysis of ammonia content of boiler waters down to parts per billion. Included is a proposed methodology for determining ammonia content of gaseous streams.

396 Automatic Treatment Control — Methods for automatic control of water treatment plants are discussed in 8-pp Technical Reprint T-179 by Graver Water Conditioning Co. In two parts, Part I deals with control of demineralization plants and covers regeneration, quality control of effluent, conductivity, pH control. Part II considers control of cold process softening and clarification units, hot process-hot zeolite systems and sodium zeolite systems.

397 Corrosion Control — Methods used in steam-condensate systems for control of corrosion are described in Process Bulletin B-6 from Nalco Chemical Co. It covers use of filming corrosion inhibitors and neutralizing amines for low, medium and high makeup.

398 Factors in Tube Failures—Available from Dow Industrial Service, Div., The Dow Chemical Co., is an 8-pp technical paper, 'The Role of Copper and Physico-Chemical Factors in Steam Generator Tube Failures."

399 Cooling Water Treatment — Chemical treatment for industrial cooling water is described by Western Chemical Co. in this product bulletin. Discusses aspects of cooling water problems and how treatment can be effective in scale prevention, corrosion prevention and algae and slime control.

400 Water Conditioner—Bulletin 5008-C, Dearborn Chemical Co., presents Formula 659, a boiler and feed water conditioner for improving steam purity, reducing blowdown loss, preventing pitting. Discusses application, advantages, dosage requirements.

401 Rust Eradicator—Bulletin describes a rust eradicator for removing rust, scale, and congestion from water systems, and the service offered by The North American Mogul Products Co., for assuring protection from the damaging effects of water.

402 Industrial Water Service—The importance of water to industry and advantages of an industrial water consulting service are detailed in 22-pp bulletin by Hall Laboratories, Inc. Examples of benefits offered users of the service are given.

403 Sodium Zeolite Softeners—Described in 12-pp Bulletin 4520 by Cochrane Corp. is the sodium zeolite process of water softening. Includes information on selecting and sizing of equipment, automatic vs manual controls and capacity calculations.

404 Tray Deaerators — Features and advantage of tray deaerators designed to protect boiler tubes, internals, feedwater lines, auxiliaries and condensate return lines are detailed in this product bulletin by The Permutit Co. Explains principle of operation.

405 Automatic Valveless Gravity Filter — Advantages and applications of an automatic valveless gravity filter for use wherever gravity flow is feasible are detailed by The Permutit Co. in this 8-pp bulletin. Explains operation and lists manpower, instrumentation and auxiliaries eliminated.

406 Feedwater Heaters—Construction details and operating features of company's feedwater heaters are described in 16-pp Bulletin YHT 102 of Yuba Consolidated Industries Inc. Illustrates and describes component features, includes installation photos.

To use Post Cards, circle item numbers of catalogs wanted

407 **On Zeolite Softeners** — "Care and Operation of Zeolite Softeners," covers bacterial fouling, deposits encountered and operational factors in relation to this equipment. Prepared by Betz Laboratories, Inc., it tells too, how exchange material should be handled to maintain maximum efficiency.

408 **Ion-Exchange Controls** — In Bulletin E-158, Illinois Water Treatment Co., describes automatic control systems for ion-exchange equipment.

409 **Treatment Instrumentation** — Provided in 30-pp Booklet D97-2 of Minneapolis-Honeywell Regulator Co. is a compilation of article reprints on instrumentation for treatment of water and sewage. What instruments are used, how used and their functions.

410 **Sewage Treatment Plant**—Outlined in this manual by Smith & Loveless is engineering data on small factory-built sewage treatment plants. Methods of treatment are covered and selection tables, design characteristics, and installation diagrams are included.

411 **Water, Sewage Treating**—Water, sewage and industrial waste treatment equipment of Link-Belt Co. is described in 20-pp Book 2617. Illustrates equipment and shows flow diagrams of installations in typical water, sewage, and waste treatment plants.

Metals

412 **Steel Weight Tables**—This 72-pp booklet, released by Jos. Dyson & Sons, Inc., contains weight tables of steel, including weights of round, hexagon, square, octagon, and flat steel bars in a wide range of thickness. Also includes decimal equivalents, tables of area and circumferences.

413 **Using Specialty Steels** — Offered by The Carpenter Steel Co., this 44 pp guide to selection of specialty steels contains information on tool and die steels; stainless steels; high temperature alloys; electronic; magnetic and electrical alloys; special purpose alloy steels; tubing and pipe, fine wire. Includes tool steel selector chart.

414 **Ferrous Metallurgy** — "Basic Guide to Ferrous Metallurgy" is a four-color chart prepared by Tempil Corp. showing principal characteristics of steels (with carbon content ranging to 0.9 per cent) across the temperature range to 1900 F. Important working zones including preheating for welding, stress relieving, normalizing, annealing, carburizing shown.

415 **Steel Analysis**—In this 20-pp pocket-size booklet, Jones & Laughlin Corp. lists compositions of 40 stainless steels, 184 alloy steels and 105 carbon steels most often used in industry. It also contains federal specifications with SAE, AISI and AMS numbers.

Materials and Maintenance

416 **Refractory Mortar** — This is a 24-pp manual covering the use of Lumnite calcium-aluminate cement as a mortar mix for gun-applied linings in power plant refinery and metalworking equipment offered by Universal Atlas Cement Div., United States Steel Corp. Includes data on mortar preparation, placing procedures.

417 **Handbook on Waterstops**—In the 24-pp Kwik-Seal Waterstop Technical Manual of The Gates Rubber Co. is a wealth of practical information on waterstops and their use. Covers size and shapes of the waterstop, comparative data for rubber and plastic types, handling and storage.

418 **Concrete Admixtures** — This 32-pp bulletin is issued by The Master Builders Co. as a guide to concrete admixtures, iron-armoured floor products, grouting and waterproofing materials and other related products for improving concrete and mortar. Contains comprehensive specifications for concrete floors, equipment grouting and masonry mortar.

419 **For Masonry Anchoring**—Catalog 25 is a 48-pp pocket-sized handbook of anchoring and drilling devices produced by The Rawlplug Co., Inc. for fastening anything to masonry. Includes tables showing proper anchors for each type of fixture and material.

420 **Masonry Fasteners** — Fifty-pp pocket-size Catalog 160 of Diamond Expansion Bolt Co., Inc. lists anchors and fasteners for masonry and hollow walls. Covers machine screw anchors, lag screw expansion shields, machine bolt expansion shields, closed back machine bolt expansion shields, masonry drills, anchors.

421 **Grating, Treads** — Safe load tables, specifying and fastening data, and application photos on grating and treads are provided in 24-pp Bulletin 2527-R of Blaw-Knox Co. Also decribes Ponbake, a baked-on epon paint process used.

422 **How to Use Wire Rope**—Comprehensive information on use and abuse of wire rope is presented in this pocket-size 92-pp manual offered by Macwhyte Wire Rope Co. Covers selection of wire rope, constructions, capacities, maintenance and lubrication, breaking-in of wire rope, approved methods of seizing wire rope.

423 **100 Power Tools**—Information on electric power tools and accessories for construction, maintenance and other applications is presented by Skil Corp. in this 68-pp 1961 catalog. Specifications and selection tables are included for worm-drive power saws, metal-cutting power hacksaws, all-purpose reciprocating saws, jig saws, drills.

424 **Pneumatic Power Tools**—Specifications and descriptions of grinders, sanders, drills, reamers, screwdrivers, nutrunners, filing and cutting tools are featured in pocket-size Bulletin 70 of Airetool Mfg. Co.

425 **Portable Pneumatic Tools** — Pneumatic drills, grinders and accessories are described in 20-pp Catalog PT-58B of Thomas C. Wilson, Inc. Specifications, applications covered.

426 **Tool Buyers' Guide** — Catalog 60, complete with specifications and prices, is a 68-pp ordering book on Double Circle tools of Chicago Latrobe. Covers drills, reamers, end mills, countersinks, carbides, counterbores, others. Also provides information on features and applications.

427 **Grinding Wheel Chart** — Information contained in this chart is based on rules and regulations established by the American Standard Safety Code for use, care and protection of abrasive wheels. Prepared by the Grinding Wheel Institute, it lists "do's and don't" of wheel care.

428 **Tips on Grinding Wheels** — Over 1600 abrasive wheel recommendations for grinding everything from agate to zirconium are set up in alphabetical order by The Carborundum Co., in this specification catalog, about 57-pp. Material, work, operation — with their respective recommendations on abrasive, grit, grade—are listed.

429 **Pipe Fitters Manual** — Information expected to be at the finger tips of pipe fitters and pipe welders is concentrated into this 72-pp fitters manual offered by Tube Turns Div., Chemetron Corp. Text, tables and illustrations in the pocket-size handbook give important mathematical, physical, chemical and metallurgical data and related design, layout.

430 **How to Bend Conduit** — This 12-pp pocket-size booklet of Appleton Electric Co. gives instructions for making precision bends in electrical metallic tubing, rigid steel, and rigid aluminum conduit. Covers five fundamental bends—angle bends, stub lengths, back-to-back bends, offset and three-bend saddles. Diagrams show techniques for on-the-spot bending.

431 **Brazing Techniques**—This 24-pp manual contains data for brazing shapes, sheet, castings, tubing and assemblies of aluminum, cast iron, copper, brass and steel. Covers such basic functions as heat, flame and torch settings, alloys selection and joint design. Solutions to common brazing problems are answered by All-State Welding Alloys Co., Inc.

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432 Conduit Bending — Illustrated Bulletin 260, on bending conduit or pipe easily and accurately, features an improved bender. Prepared by Lidseen of North Carolina, booklet covers calculating lengths of legs, locating bend, back-to-back method, back-to-back push-through.

433 Soldering Tools—Catalog S-60 of Ungar Electric Tools contains 8 pp of detailed information on soldering tools featuring interchangeability. A temperature chart for various applications is included.

434 Guide to Preheat—Welding of low-alloy high-tensile steel and other alloy steels with the aid of preheat is explained by J. B. Nottingham & Co., Inc., in 40-pp "A Guide To Preheat." Physical and chemical changes that take place in these problem steels during and afterwelding outlined.

435 Arc Welding — Basic information concerning arc welding techniques for small diameter piping is contained in Lincoln Electric Co.'s Bulletin 2112.3. Lists advantages of welded piping installations; describes procedures, explaining calculation of welding costs.

436 Welding Data — This 148-pp pocket-size maintenance welding data book, issued by Eutectic Welding Alloys Corp., provides a guide, indexed by application, to nearly 200 rods, electrodes, and chemical aids. It illustrates and explains general welding techniques and joint design hints, and covers elimination of warping, distortion, embrittlement.

437 Vest Pocket Welding Guide — This revised edition of "How to Get Better Welds," published by Hobart Brothers Co., contains 80 pp of arc welding information. Covers essentials for proper welding procedures, good and bad welds, welding positions, operator qualifications, welding metals and steel available for welding. Also deals with causes and cures of common welding troubles.

438 Tips on Welding — This 56-pp welding, brazing and soldering alloy and flux catalog and instruction manual issued by All-State Welding Alloys Co., Inc. covers physical properties, major uses, detailed application instructions and latest techniques for welding, brazing, soldering, cutting and hardfacing.

439 On Welding Electrodes — Contained in this 64-pp electrode pocket guide of Air Reduction Co., Inc. is information on all types of electrodes including mild steel, low alloy, low hydrogen, iron powder, stainless steel, hardfacing, non-ferrous and cast iron. Covers applications, procedures and pertinent data on each electrode.

440 Corrosion Protection — Stackfas, a coating designed by Benjamin Foster Co. to protect chimneys of all types against attack from acid flue gases, is discussed in 6-pp bulletin. Applications given.

441 Corrosion, Abrasion Control — Practices and products for the protection of metal equipment from corrosion and abrasion are discussed in 16-pp bulletin of Goodall Rubber Co. Covers applications of rubber or synthetic linings to metal parts or products, and maintenance coatings available.

442 Efflorescence, Chalking—Causes of efflorescence and early chalking on painted masonry surfaces, and ways to overcome and prevent such deterioration are explained by Rohm & Haas Co. in this 48-pp booklet. Discusses paint formulation and compares four major types of emulsion vehicles for resistance to alkali, moisture, heat, and ultra-violet light.

443 Power Plant Cleaning — This fact file of Chas. Pfizer & Co., Inc. includes Data Sheet 557 on chemical cleaning with citric acid solutions, organic acids for cleaning power plant equipment, operation and water conditioning of a power plant, and Technical Bulletin 102 on cleaning products.

444 Chemical Cleaning Services — Specialized cleaning facilities offered by Dow Industrial Service, Div., The Dow Chemical Co. are detailed and illustrated in 8-pp Form 1. Services, available on nation-wide basis to utilities, chemical plants, refineries, paper and steel mills etc., include chemical filling, cascading, foaming, jetting.

445 Powdered Acid Cleaner — Bulletin HSP-940 describes a powdered acid cleaner, made by Hagan Chemicals & Controls, Inc., for use in cleaning scale deposits from boilers, heat exchangers, water lines, pumps and other equipment. Advantages are listed and methods of application outlined.

446 Painting Galvanized Steel — Effective techniques for painting galvanized steel sheets, are explained in this 16-pp booklet, produced jointly by the American Iron and Steel Institute, the American Zinc Institute, and the National Paint, Varnish and Lacquer Ass'n. Discusses main reasons for this painting: appearance, heat reflection.

447 Aluminum Paints in Color — Protective and decorative advantages of painting with aluminum in color are discussed by Aluminum Co. of America in Form 30-11451. Illustrated in full color, shows examples of use of this metal-bright paint on structures.

448 Protection Against Rust—This 38-pp treatise (Form 259) on rust and corrosion control by protective coatings shows actual color standards of Rust-Oleum Corp.'s primers and top coatings. Covering water resistant, heat resistant floor coatings, galvanized metal coatings, quick-dry coatings. Bulletin contains full-color application photos and 110 color chips.

Lubrication

449 Lubricant Data—Characteristics, advantages of specialized fluid and grease type lubricants are described in 32-pp Data Book 59-2, by Lubriplate Div., Fiske Bros. Refining Co. Includes sections on control of friction, use of grease type lubricants, proper applications, and recommendations for various conditions.

450 Organized Lubrication — Benefits of organized lubrication are extolled by Texaco, Inc. in this 24-pp bulletin. Cost control opportunities are detailed, and task of assigning responsibilities in an organized lubrication system are discussed.

Motive Power

451 Large Generating Units — Design and construction features of large steam turbine generating units are illustrated and described in 40-pp Bulletin 03B9448, Allis-Chalmers Mfg. Co. Subjects covered range from compact component design to controls and instrumentation. Illustrated with photos, drawings and section diagrams. Includes ratings.

452 Steam Turbines—Single Stage turbines for mechanical drives are featured by Murray Iron Works Co. in 6-pp Bulletin T-126. Schematic drawings showing features.

453 Industrial Gas Turbines — Versatility of General Electric Co.'s gas turbines as a power source for a variety of industrial and other applications, including power for emergency generator sets, is detailed in 16-pp Bulletin GED-5685. Includes review of engine specifications.

454 Gas Turbines—The power concept of The Cooper-Bessemer Corp.'s gas turbine based on the J-57 jet engine is discussed in 8-pp Bulletin 95. Describes operating characteristics, thermal efficiencies, maintenance costs, and potential applications.

455 Industrial Gas Turbines—Advantages and economies of industrial gas engines made by Orenda Engines Ltd. for general industrial and other applications are outlined in this 24-pp bulletin. Performance data and curves, dimensions, operating costs curves, heat recovery data.

457 Gas Turbine Power—Eight-pp Bulletin GEA-7083 of General Electric Co. introduces a line of 75 to 20,000-hp ultra-lightweight, compact gas turbines for a wide variety of applications, including fluid and gas pumping, electric power generation. Covers design features, performance and operating characteristics.

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458 Gas Turbine Engine — Saturn T-1000, an industrial gas turbine engine manufactured by Solar Aircraft Co., weighing 1200 lb and rated 1100 hp, is detailed in Bulletin T-1000. Advantages, performance data, characteristics are included.

Safety

459 Fire Control Tips — This fire control chart, AD3003R8, shows fire extinguishers and gives detailed information including ratings. Prepared by Walter Kidde & Co., Inc., gives data on Class A, B and C fires and suitable extinguishers.

460 Fire Alarm Systems—Publication 246 of The Standard Electric Time Co. contains 36 pp of detailed information on fire alarm systems for critical applications in industrial, institutional and other public buildings. Contains typical job specifications covering all systems.

461 Handling Flammable Liquids—Problems involved in use of flammables and methods and equipment required for safe control are described by The Protectoseal Co. in this 76-pp safety handbook. Physical properties and characteristics of most commonly used flammables are detailed, and recommendations for safe handling of these liquids given.

462 Special Fire Protection — Devoted to special hazard fire protection, this 44-pp booklet of Grinnell Co., Inc. covers both equipment and methods. Tells how to recognize special fire-hazardous conditions in a plant. Discusses major types of fire protection, telling how each functions, giving advantages and limitations.

463 Color for Safety — Offered by Valdura Heavy-Duty Paint Division, American-Marietta Co., this 6-pp booklet shows a cutaway section of a typical industrial plant with all danger areas painted in appropriate safety colors. Lists recommended colors for every safety application.

464 Markers, Signs—Illustrated in full color, this 24-pp catalog of North Shore Nameplate Div., Anodyne, Inc., provides information on pipe and electrical markers, numerals, letters, safety and identification signs all available from stock. Explains how markers are applied, also includes prices, ordering information.

Insulation

475 Thermal Insulation—Described in 54-pp Catalog IN-244A are Johns-Manville thermal insulations for all types of commercial and industrial requirements from—400 to 3000 F. Contains six sections, each devoted to a specialized group of insulations, including industrial and high temperature; plumbing, heating and air conditioning; refrigeration; insulating firebrick.

477 Thermal Insulation—This 16-pp bulletin released by National Insulation Manufacturers Association is designed to serve as a guide to best use of thermal insulating materials under changing conditions of modern industry. Emphasize "economic thickness" approach to specification.

478 Insulation Specifications — In this set of six specifications, Pittsburgh Corning Corp. covers applications of Foamglas insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses of insulation to be applied, drawings of insulation procedure, supports and recommended finishes. Booklets are devoted to low-, medium-, high-, and dual-temperature equipment, to underground piping.

479 Insulating Materials — Properties and specifications of over 30 insulations for service from sub-zero to 1900 F are presented in this 24-pp 1960 catalog of Baldwin-Ehret-Hill, Inc. Spun mineral wool, calcium silicate and 85 per cent magnesia products in block, blanket, felt, fill cement, and pipe insulation covered.

480 For Insulation Protection — Comprehensive data on mastics, coatings, adhesives, and flashing compounds for thermal insulation has been classified as to industry usage—power, process, cold storage, marine and commercial—in this ready-reference loose-leaf manual, about 208-pp, of Benjamin Foster Co. Detailed application data included.

Other Equipment

481 Sheet, Plate Fabrication — A variety of parts and assemblies—from massive boiler breechings to smallest stamping — are illustrated in 40-pp Bulletin F4, of The Kirk & Blum Mfg. Co. Facilities and equipment for production are illustrated, including shearing, contour cutting, punch press, large presses, brakes, welding.

482 Hinged Closures — Quick-opening hinged closures for blanking off pipeline ends and tank or vessel openings are described by Tube Turns, Div., Chemetron Corp., in 6-pp Bulletin TT-1034. Illustrations of typical installations included.

484 Coupling Data—An integrated selection of product bulletins and data on couplings of Koppers Co., Inc., for a variety of industrial applications is presented in this handy ringbound notebook. The notebook contans sections on product literature, engineering data, instruction sheets, application data, and price lists.

485 Torque Manual — This 32-pp catalog is a recent revision of P. A. Sturtevant Co.'s popular torque manual. Includes application illustrations, bolt charts, discussions on assembly characteristics, instructions for torque wrench testing, pictures of modified and special torque wrenches, formulas and illustrated explanations for using adapters, attachments.

486 Corrosion Data Charts — Corrosive effects of almost 400 different materials on 16 types of metals are shown in corrosion data charts contained in Technical Service Bulletin 101 issued by Nooter Corp. Charts indicate corrosion resistance of metals to various chemicals.

488 Cathodic Protection — Booklet describes corrosion control for buried or submerged piping, tanks, ships and similar structures. The company's consulting services, field surveys, design, installation and materials as well as general cathodic protection procedures are discussed in detail by Harco Corp.

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490 Heavy Duty Draft Inducers—Construction, specifications and installation details of mechanical draft inducers for industrial and heavy duty units, 6- to 30-in. diam, covered in Form 104 by The Quickdraft Corp.

491 Gas Cleaning — Bulletin 500, 12-pp, describes Research-Cottrell's gas cleaning installations in the power, steel, chemical, cement, paper and other industries.

492 For Condensers, Heat Exchangers — Publication B-2, 46-pp of The American Brass Co., discusses tubes and plates for condensers and heat exchangers, applications and problems encountered. Information on condenser tube alloys, plates for tube sheets and baffles, methods, installation and corrosion is covered.

493 Tube Expanding—Tube rolling technique in thick tube sheets is discussed by the Elliott Co., in Bulletin Y-52 with methods detailed.

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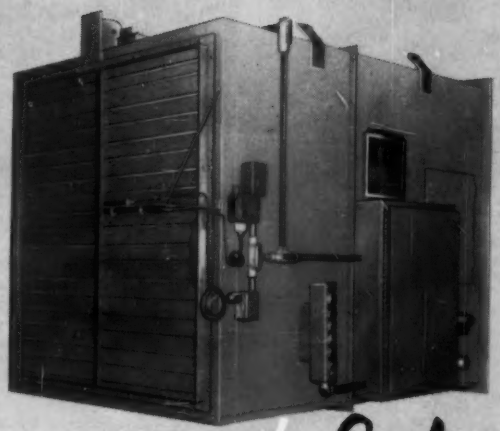

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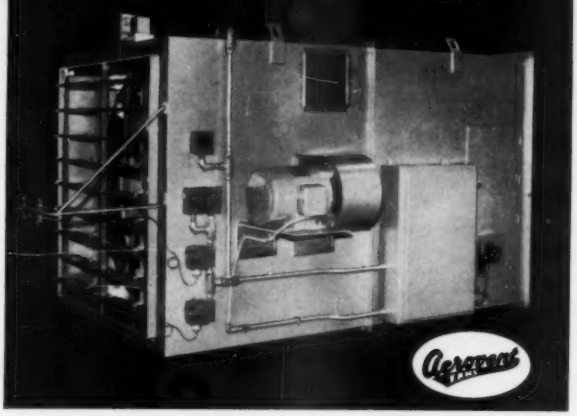

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AT 3 PLANTS OF

DETROIT EDISON

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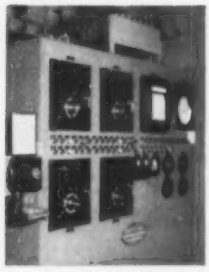
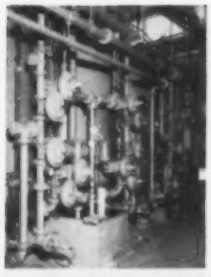


This picture, taken in the Marysville Power Plant, shows the IWT Control Panel which governs all functions of De-Ionizer regeneration. These control cabinets, which include indicating devices and recording instruments, are designed and built by IWT.

DE-IONIZERS

FOR MAKE-UP WATER



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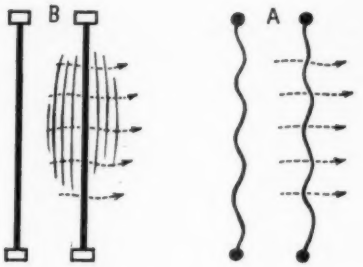

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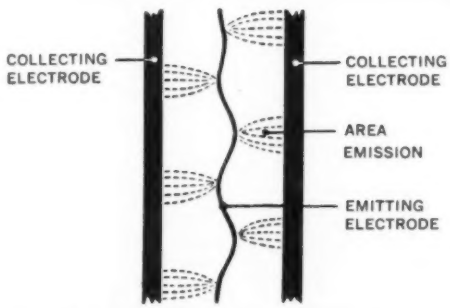

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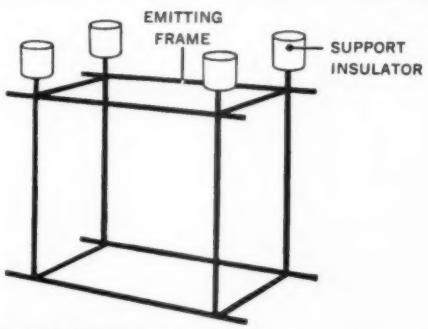

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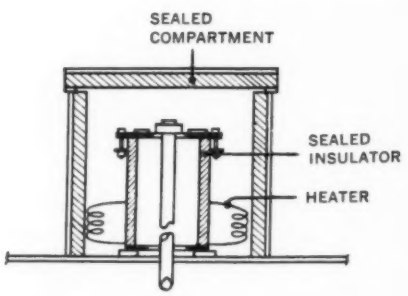

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